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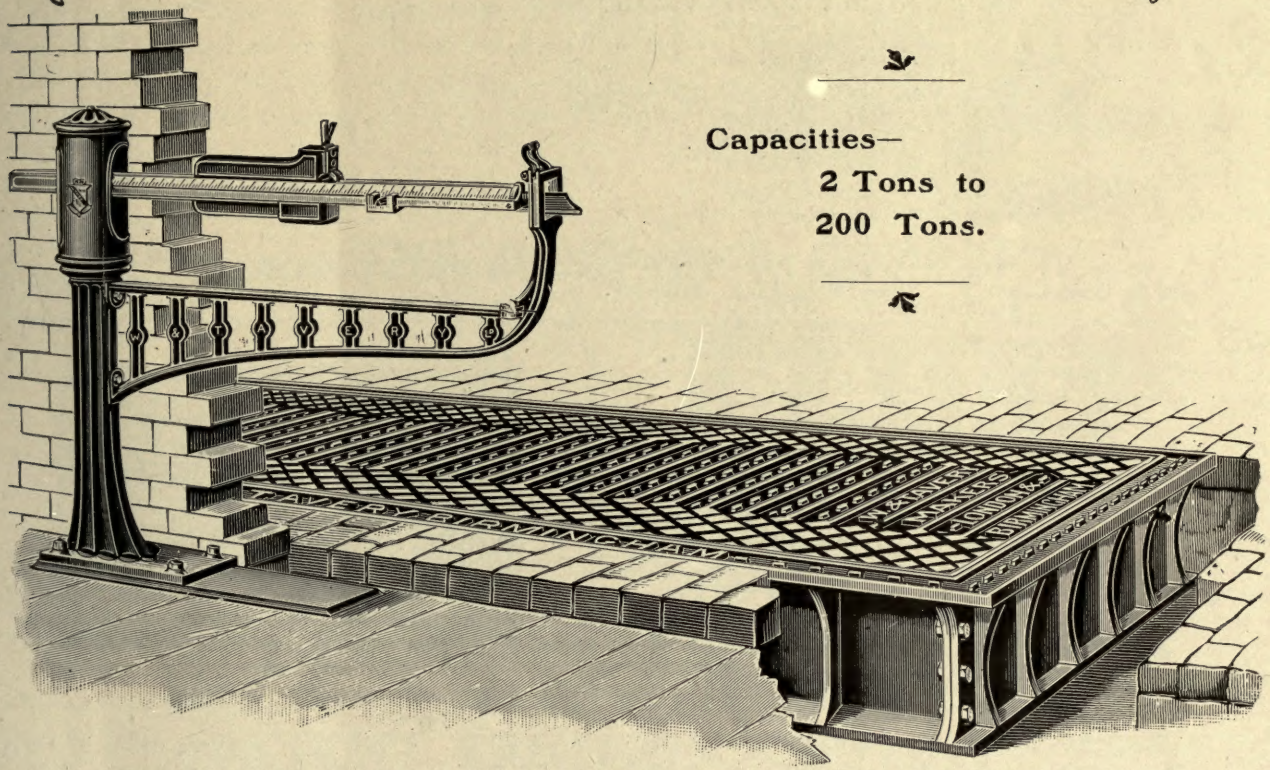
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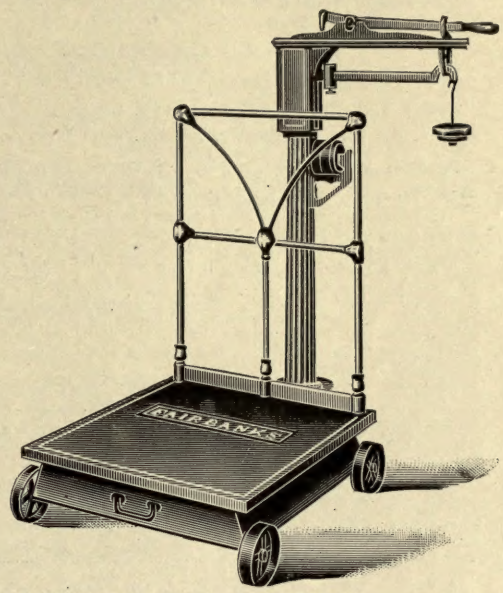
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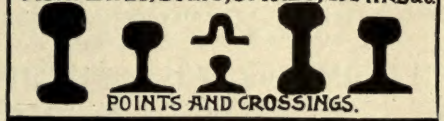
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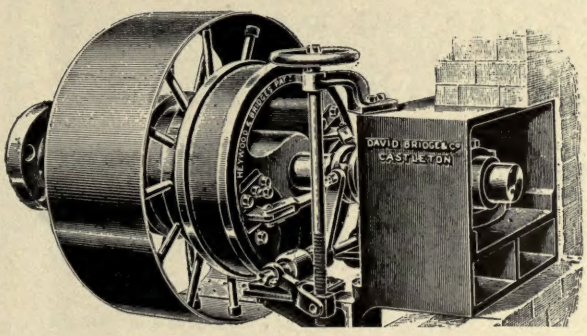


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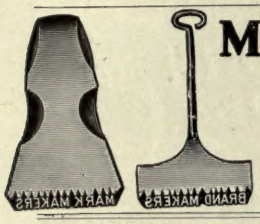
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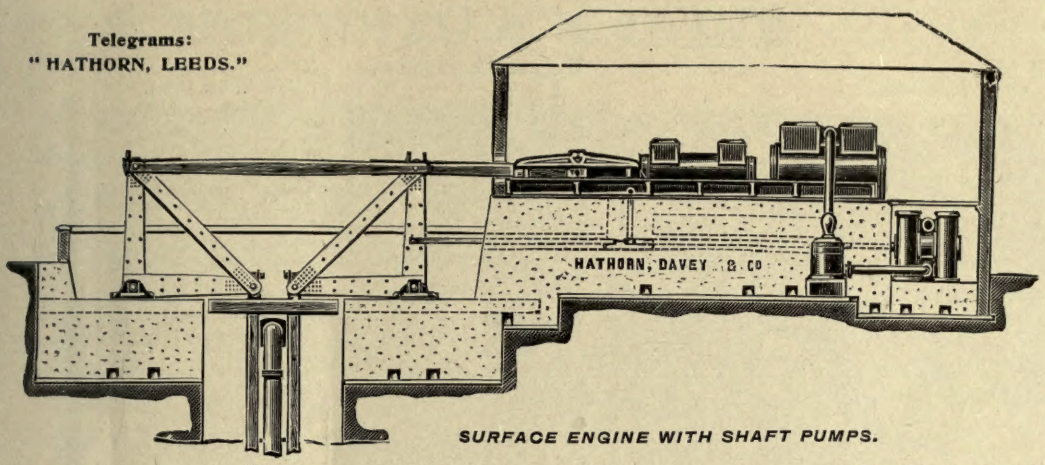
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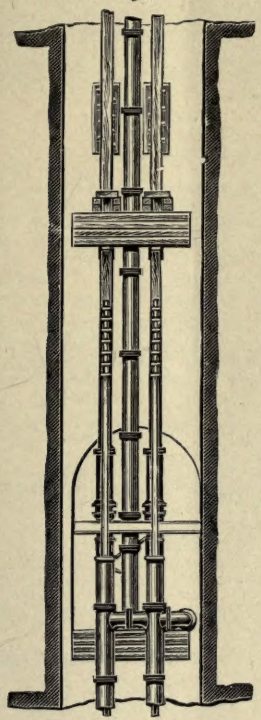
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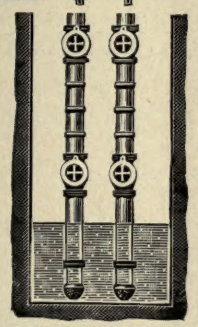
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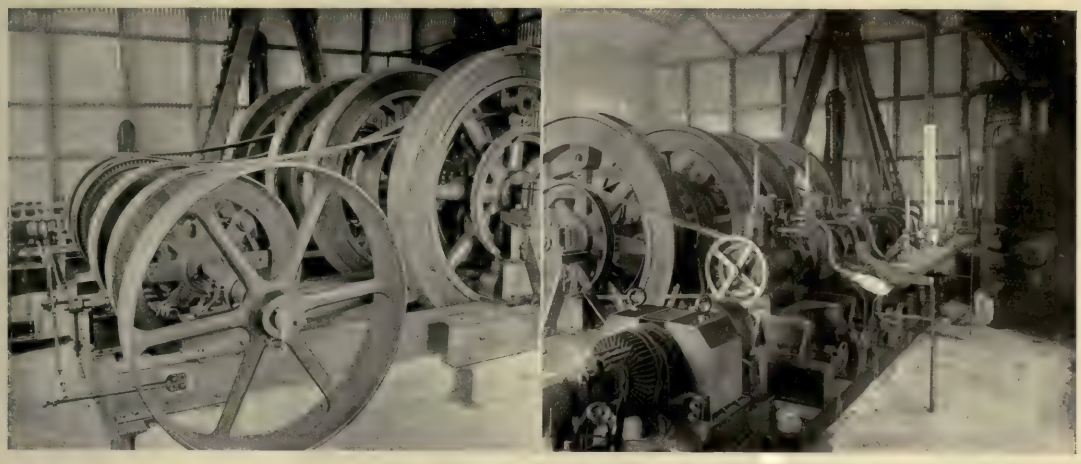
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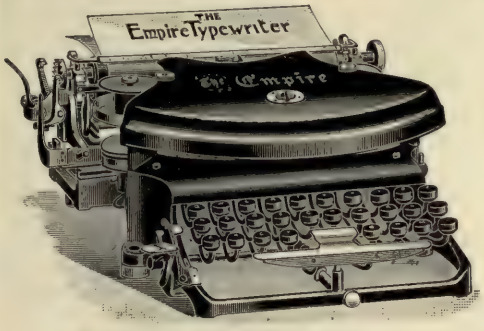
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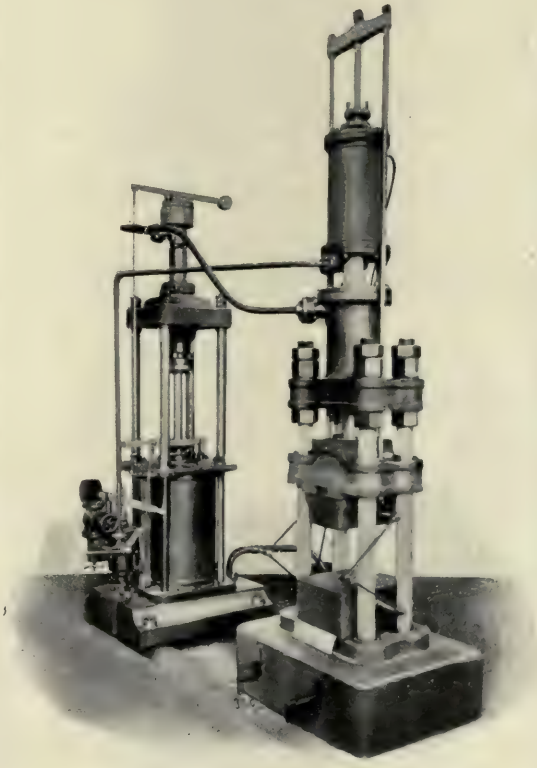
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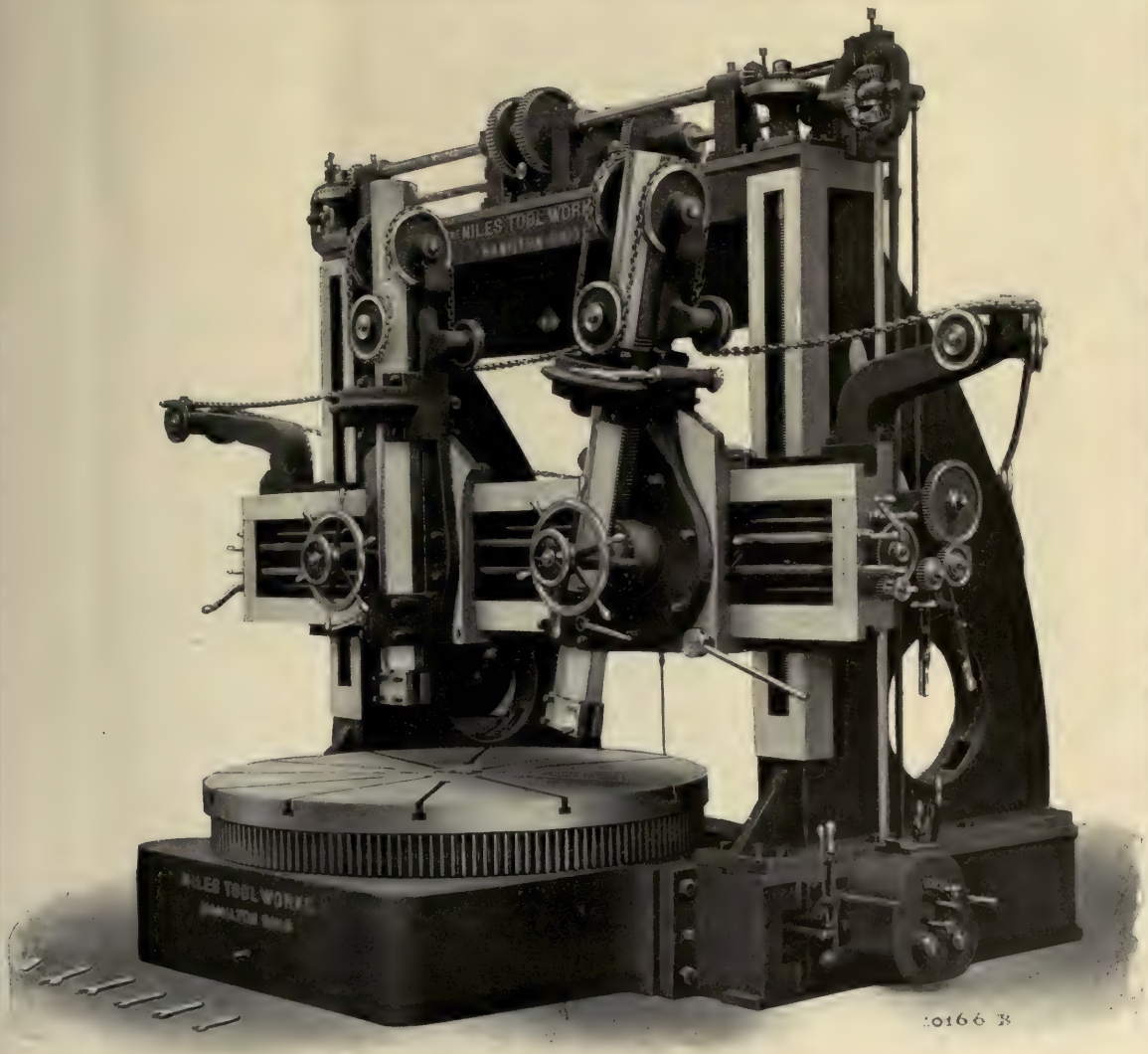
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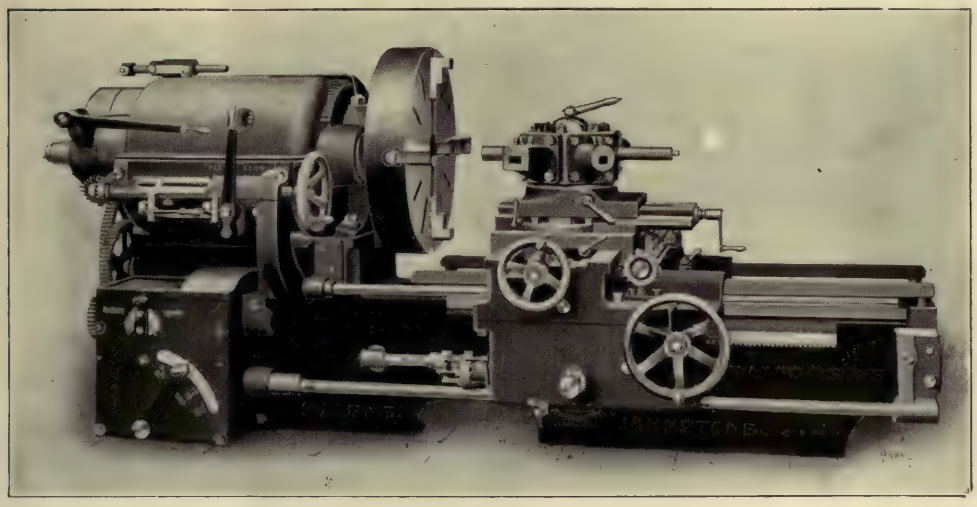
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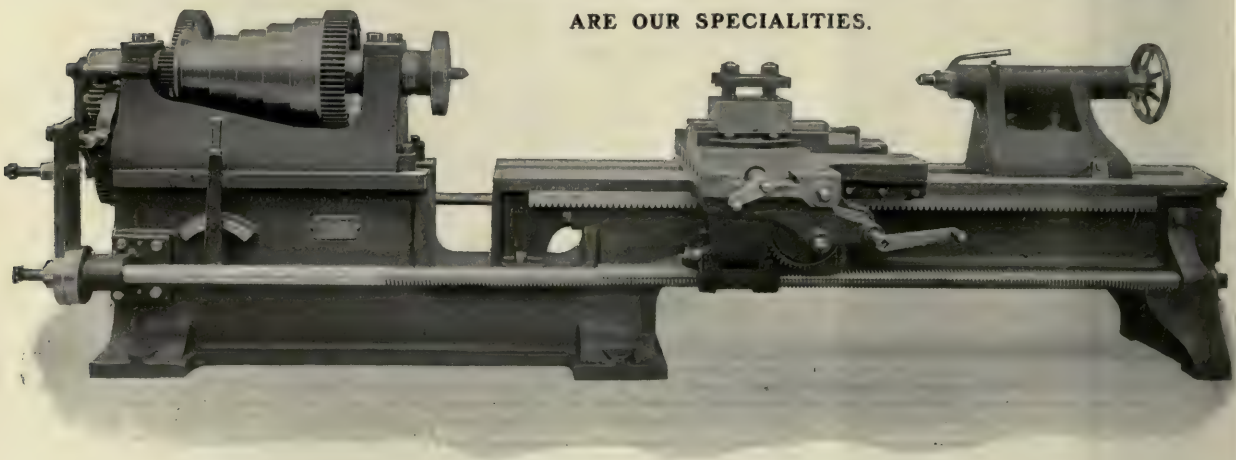
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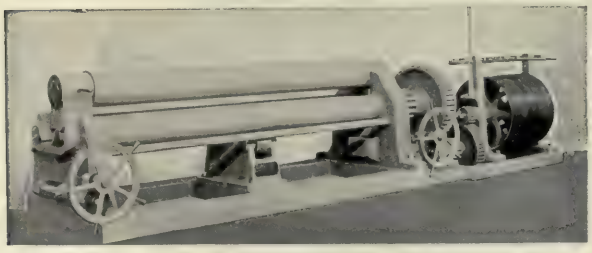
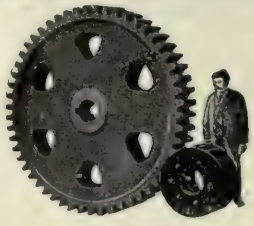


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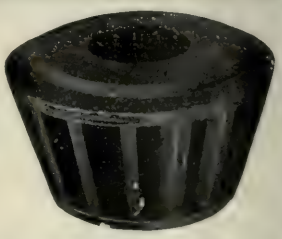
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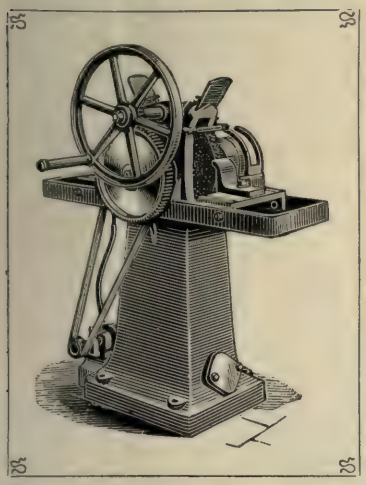
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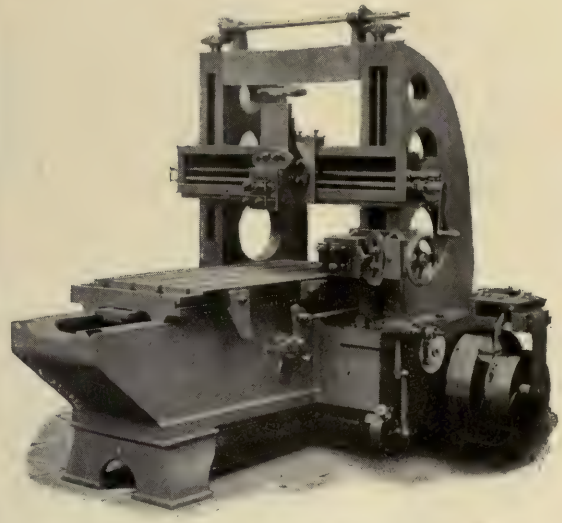
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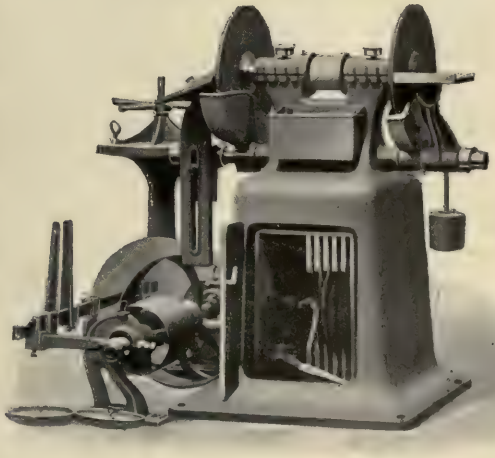
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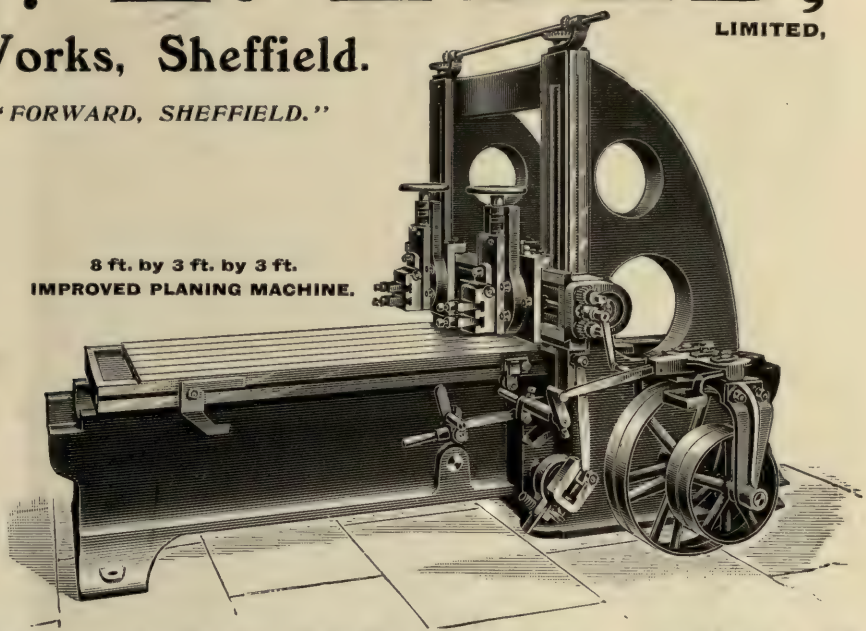
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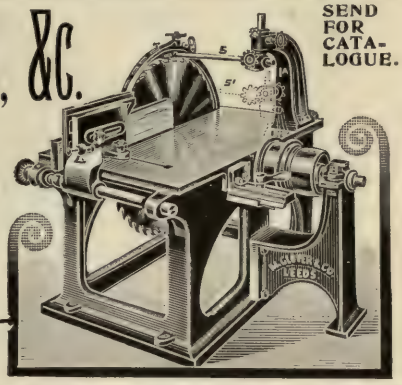
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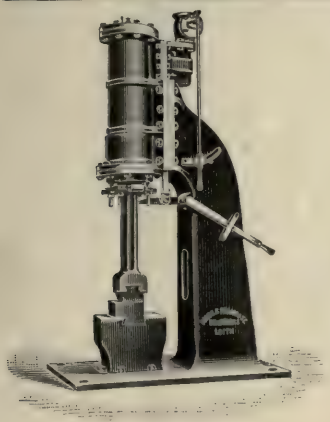
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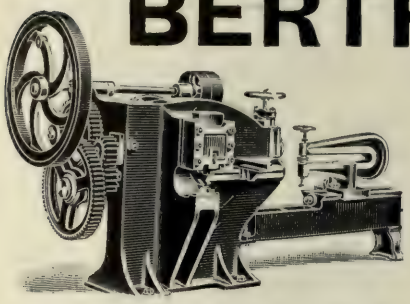
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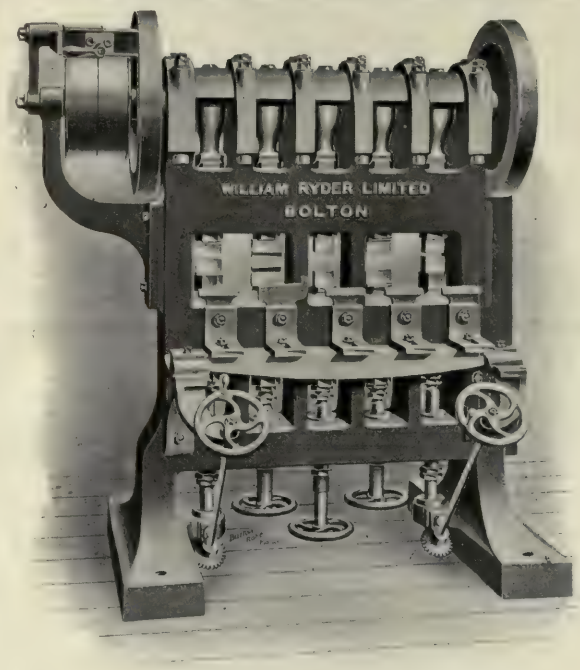
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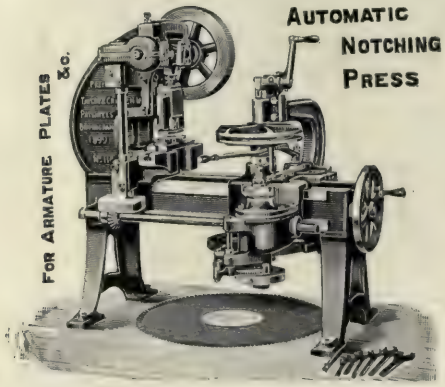
SAWING MACHINES.

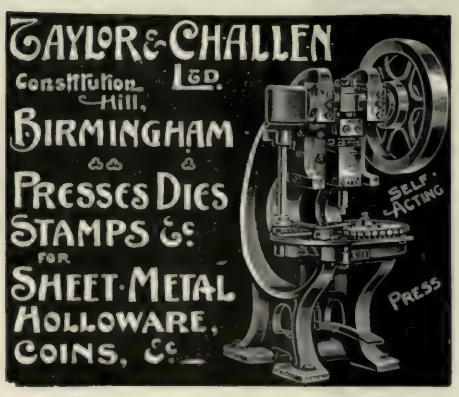
COKE BREAKERS.

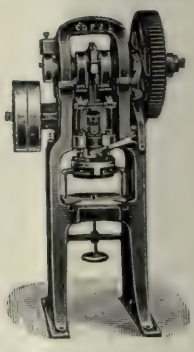
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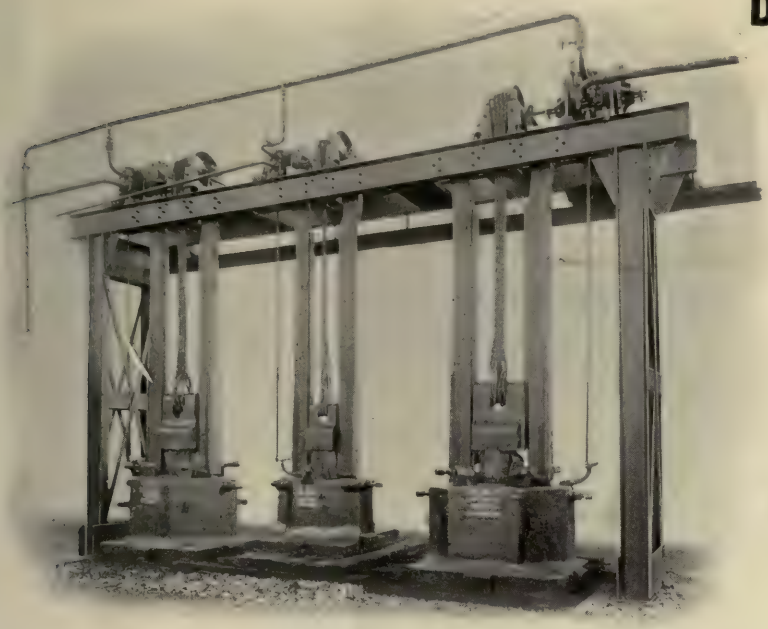
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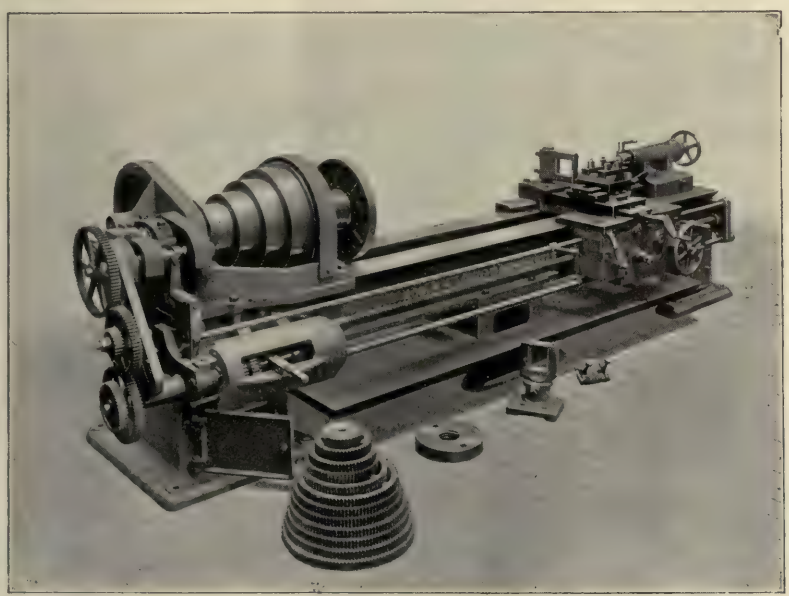
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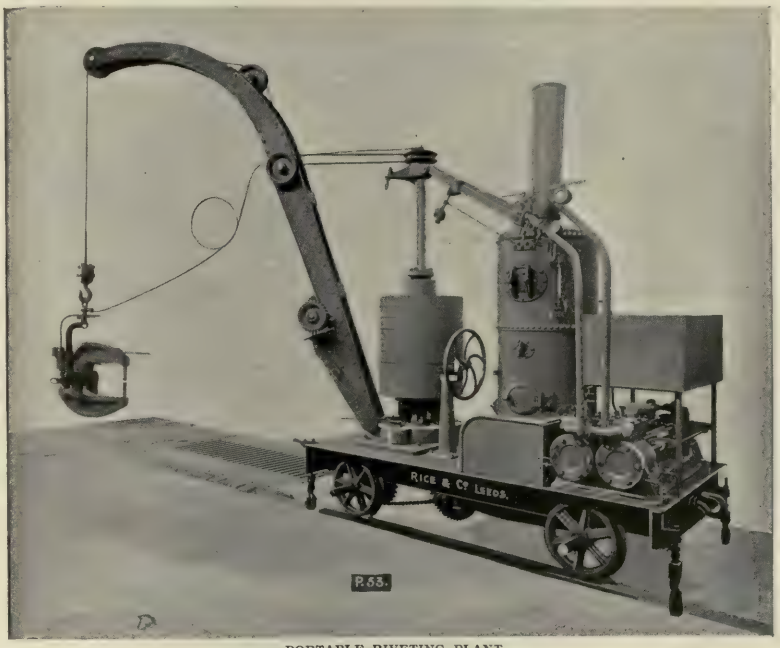
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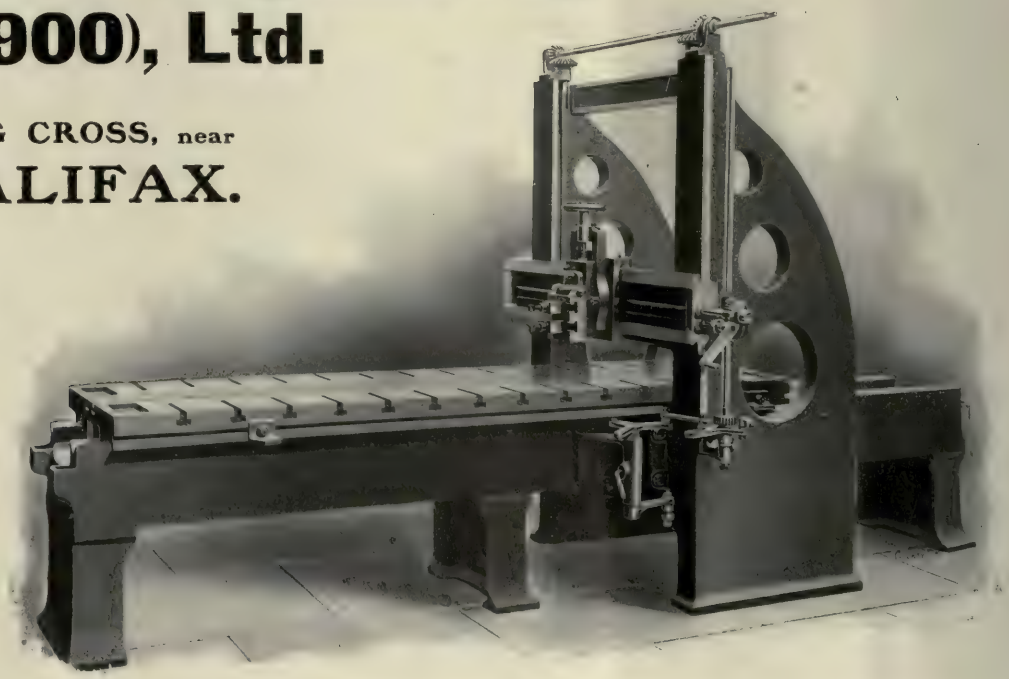
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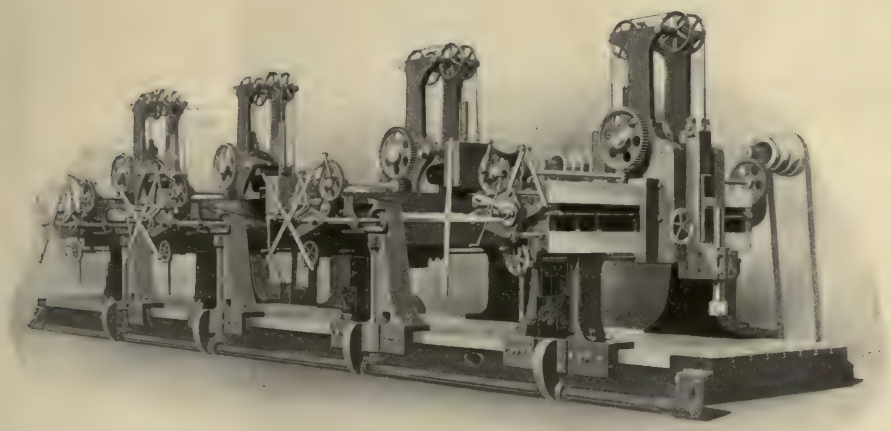
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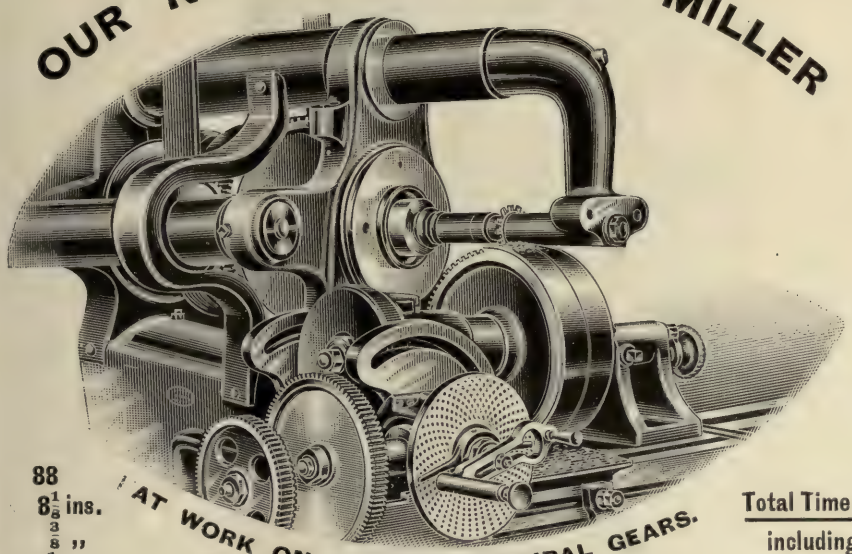
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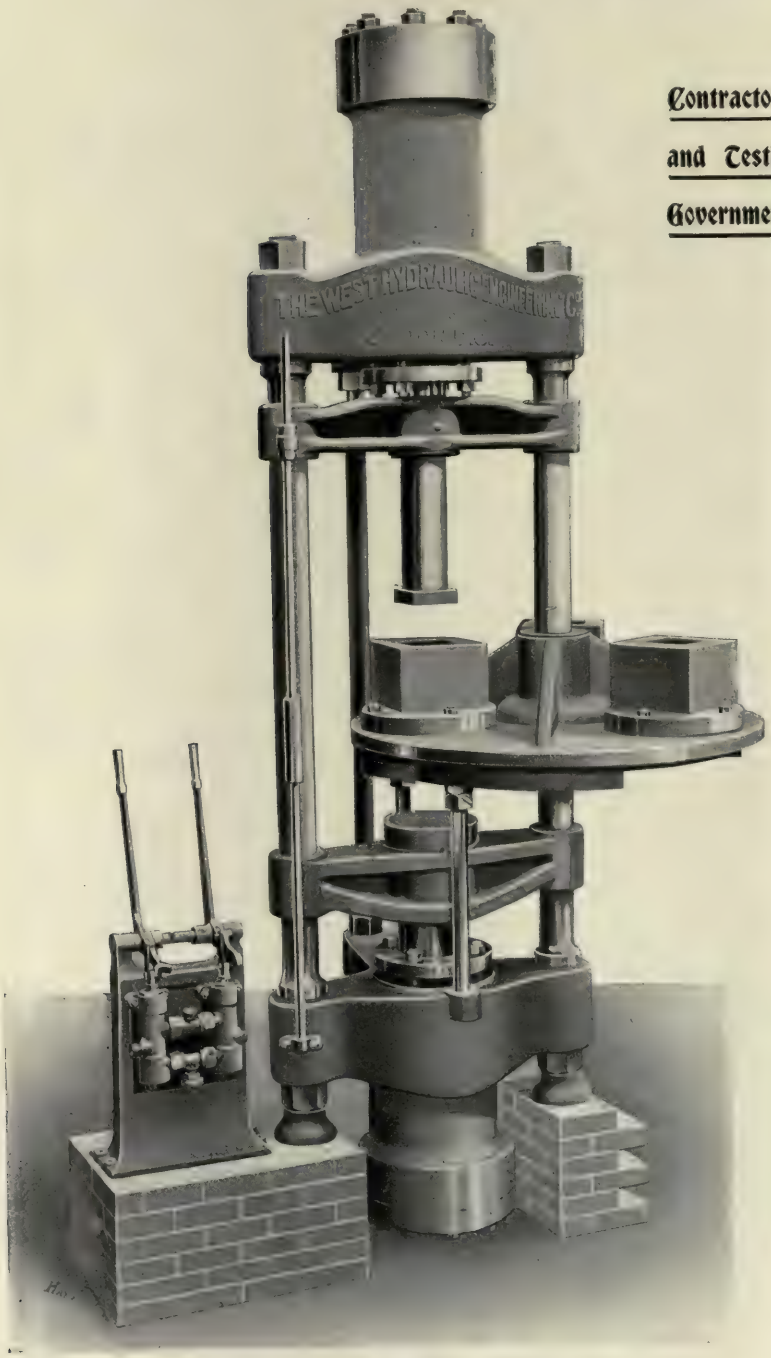
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Pitch approx.	$\frac{3}{8}$,,
Width of Face	$2\frac{1}{16}$,,
Feed per min.	$4\frac{1}{4}$,,
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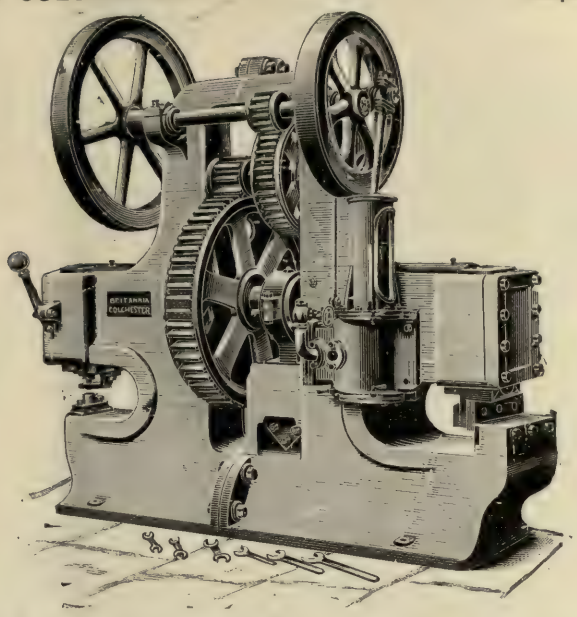
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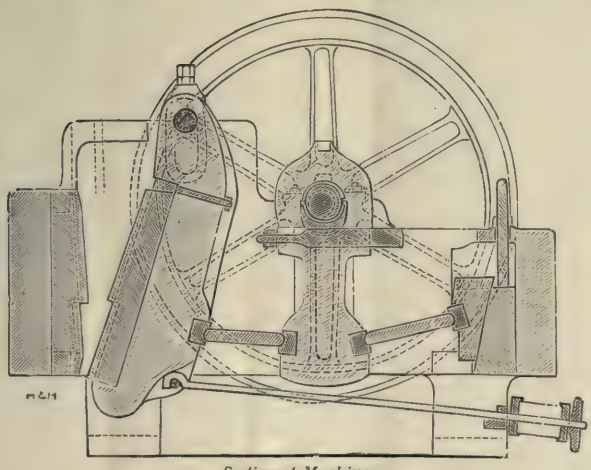
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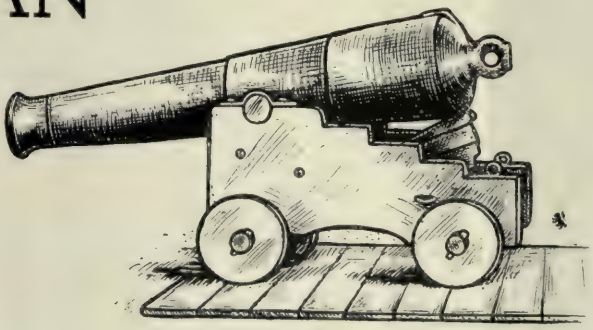
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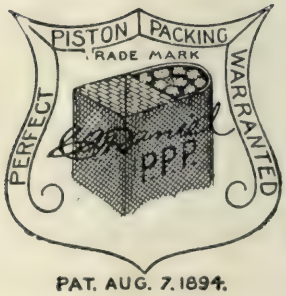
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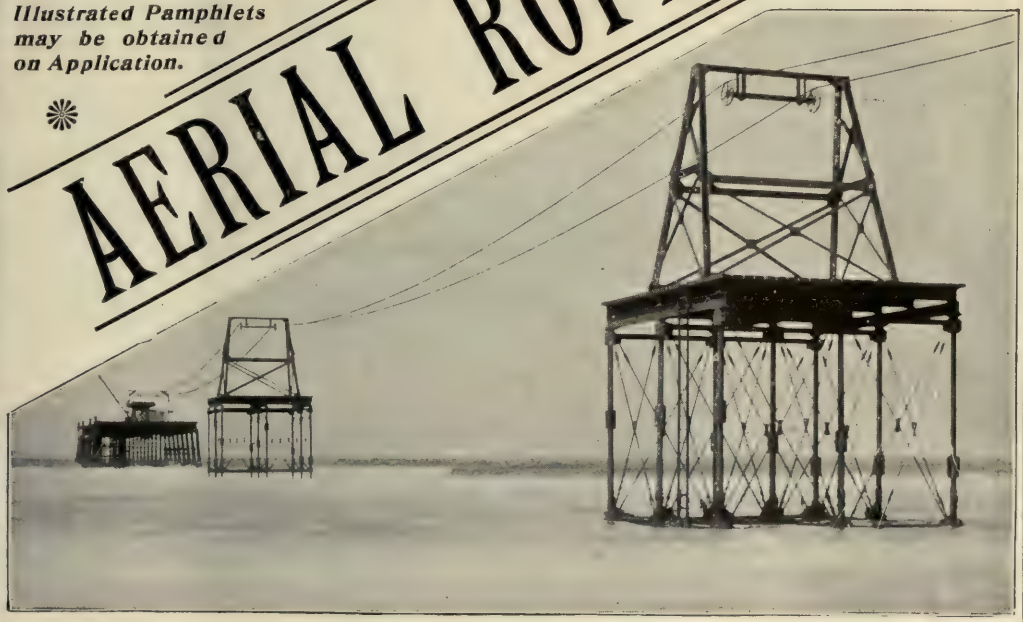
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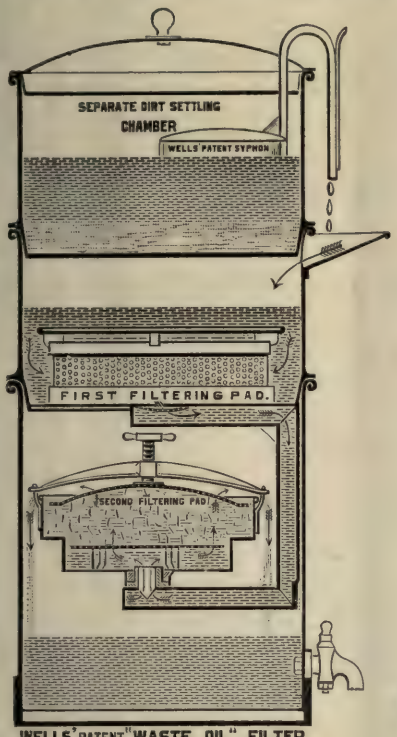
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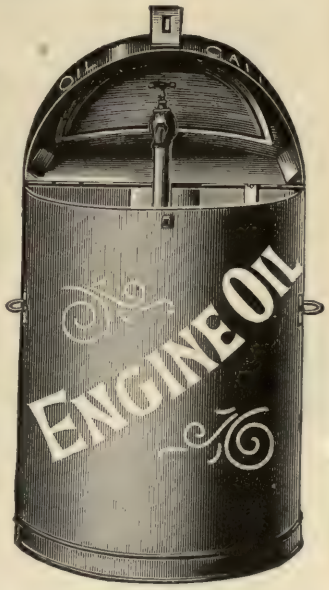
		IN.	IN.	EACH.
3 Gallon size,		8½	by 15½ ...	10/9
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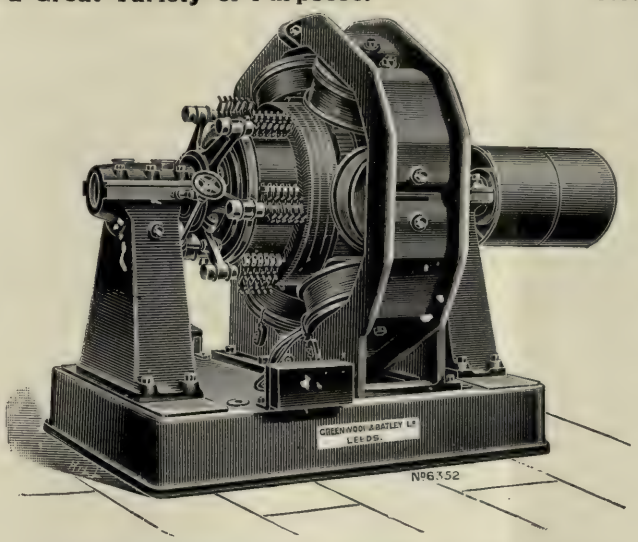
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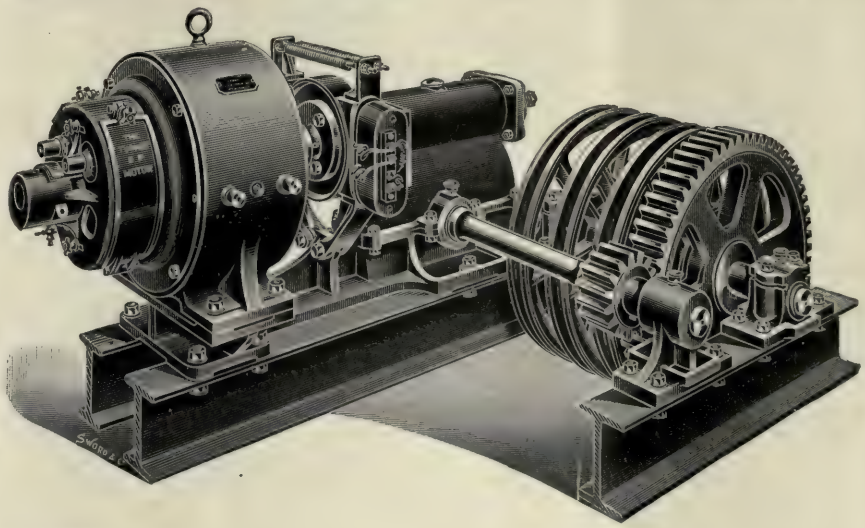
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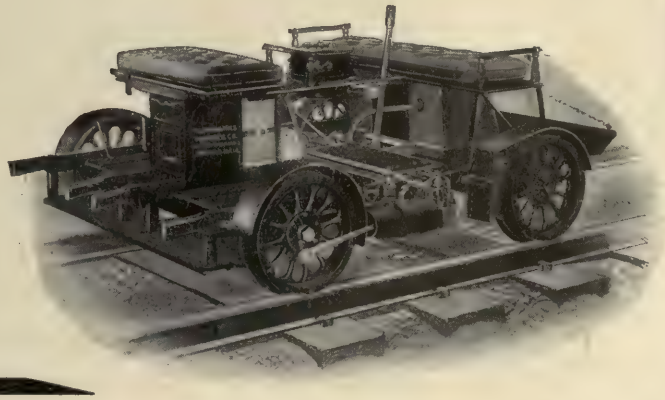
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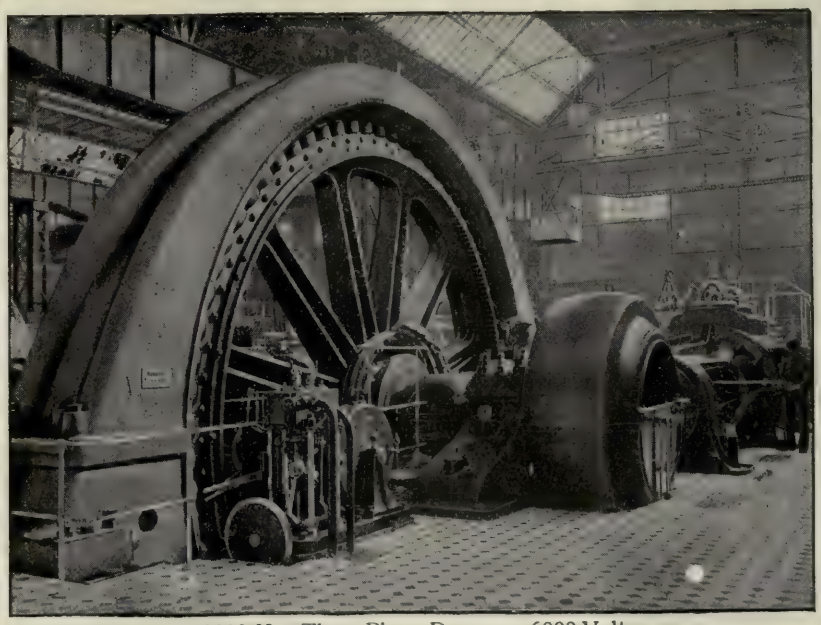


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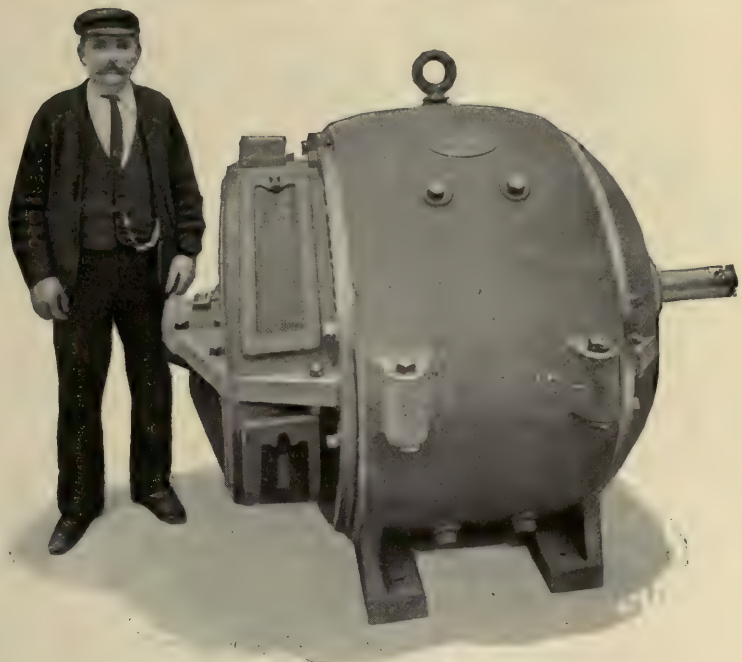
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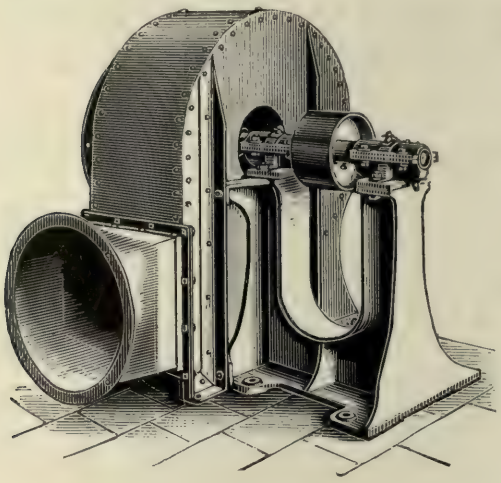
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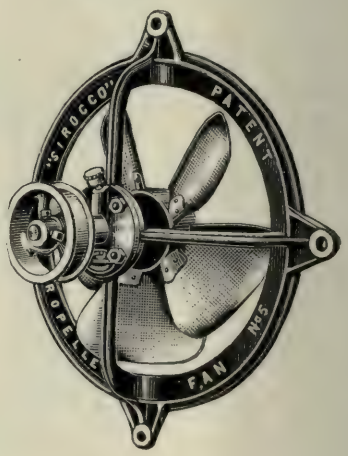
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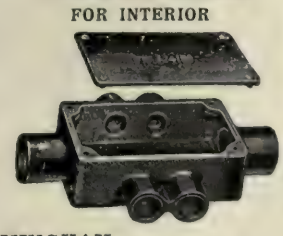
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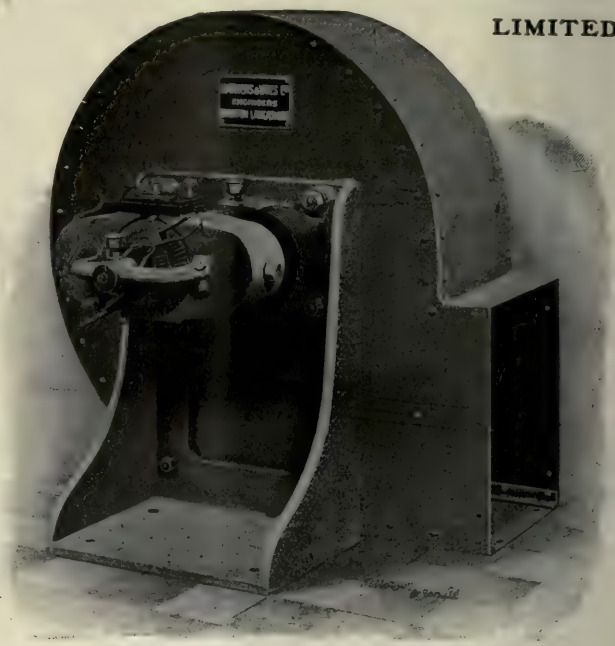
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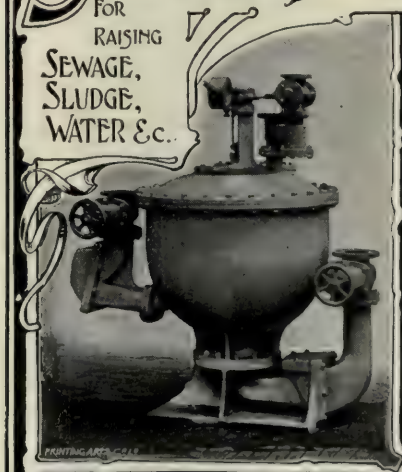
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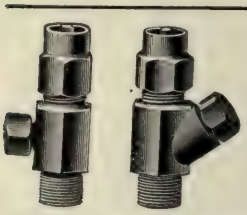
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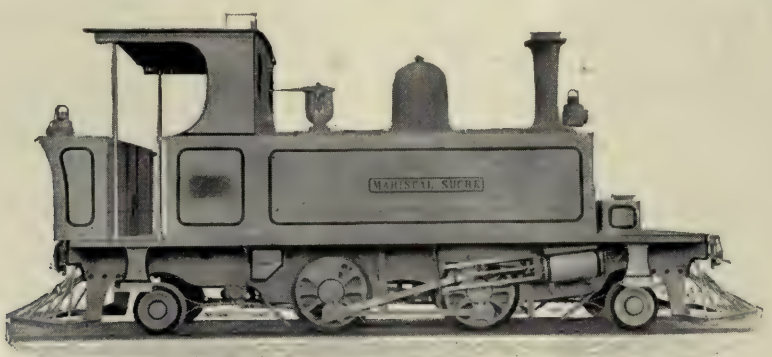
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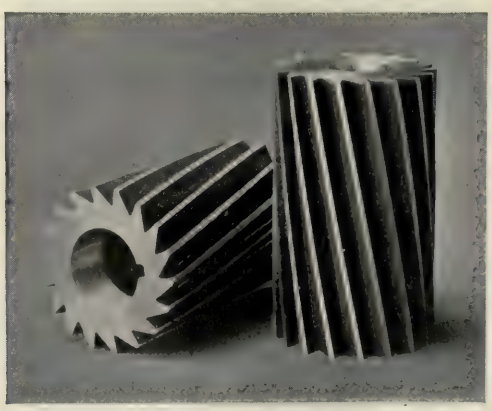
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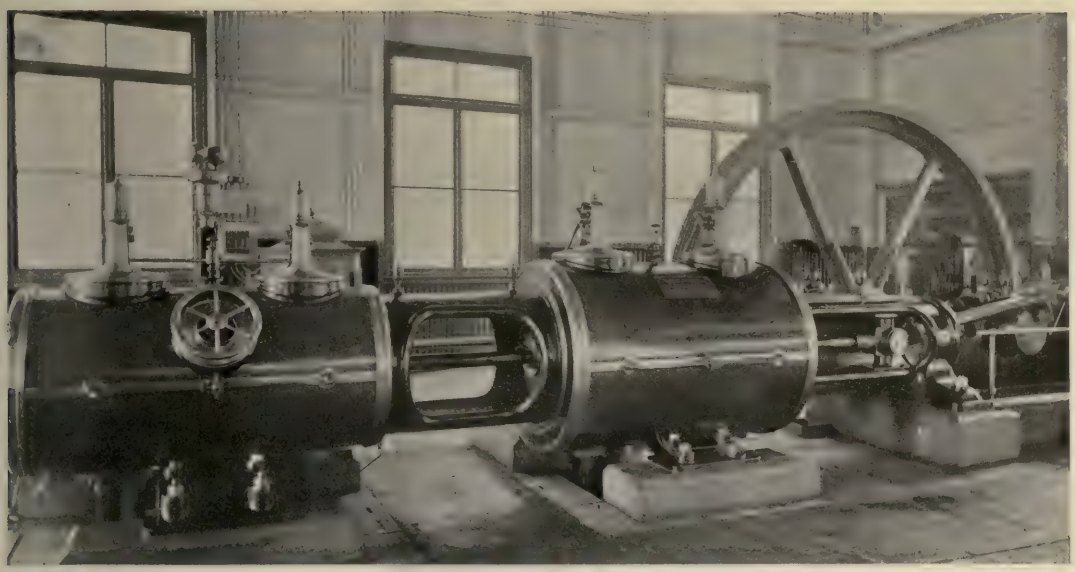


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FIG. 13. CRUSHER ENGINE, ALSO SUITABLE AS AUXILIARY FOR DRIVING MILL—LANCASTER WEST MINE, WITWATERSRAND.

THE EQUIPMENT OF THE LANCASTER WEST MINE.

BY

EDGAR SMART, A.M.INST.C.E.

In this article the author completes his description of the Lancaster West Mine, which is situated at Krugersdorp, about nineteen miles west of Johannesburg. The previous article appeared in the July number, and dealt with the Main Inclined Shaft, the Vertical Shaft, Stoping, the Cyanide Works, Settling Pits, Precipitation House, Surface Lay-Out, etc.—ED.

II.

THE BOILER HOUSE.

THE Boiler House at Lancaster West Mine contains six Büttner water-tube boilers, rated at 108 h.p. each, two Green's economisers of 96 tubes each, the feed pumps and coal bins. The boilers are designed for a pressure of 142 lb. and each has 1,425 square feet of heating surface and a grate area of 32·7 square feet.

In many respects their construction resembles that of the well-known Babcock and Wilcox type, as, for instance, in the method of supporting the cylindrical shell in bands suspended from girders carried on top of the buckstays. The shell is 21 ft. long and 4 ft. 3 in. in diameter. Figs. 9, 10 and 11, illustrating the construction of these boilers, have been prepared from

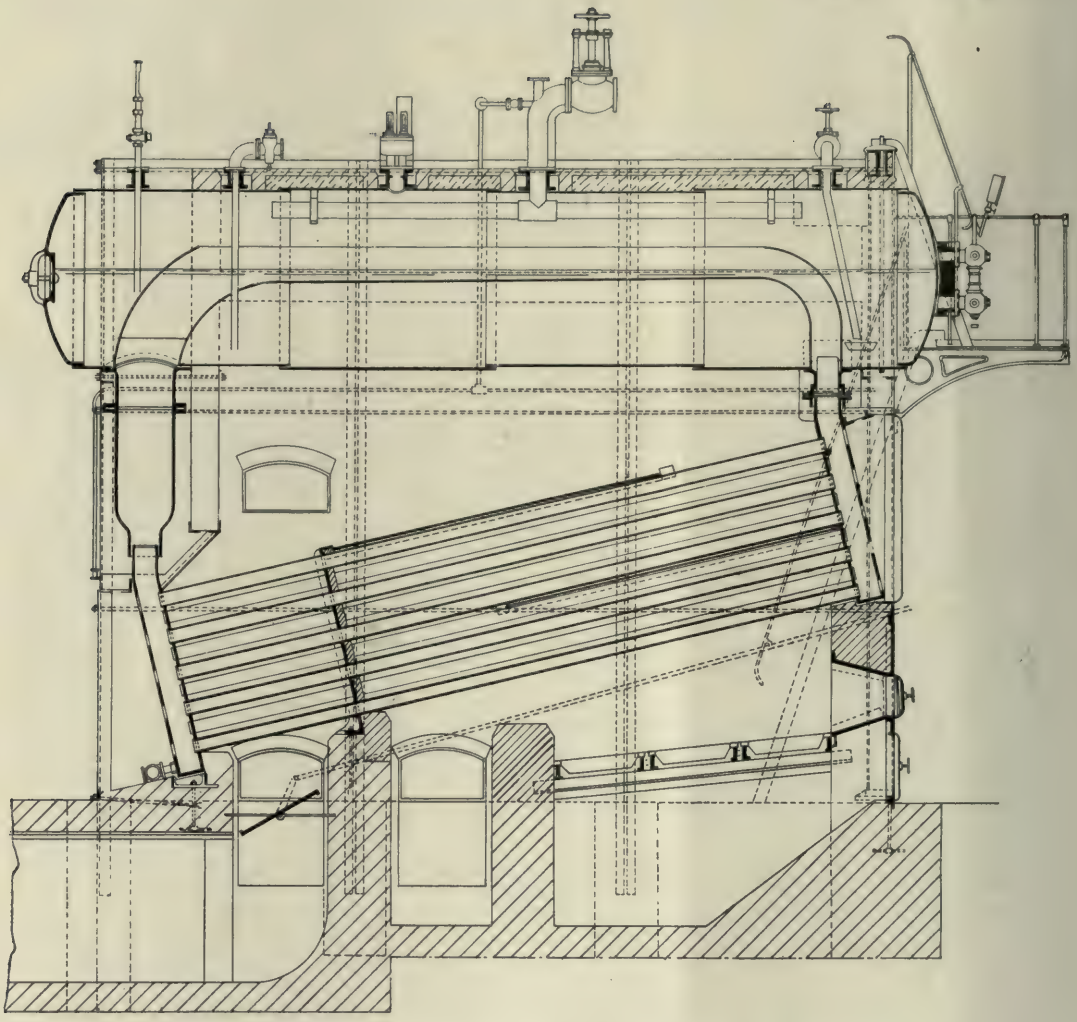


FIG. 9. BÜTTNER WATER-TUBE BOILER—LONGITUDINAL ELEVATION.

drawings supplied by Mr. G. Schorkopf, of Johannesburg.

The chief feature of novelty is in the construction of the headers, which instead of being built up of steel castings in the usual manner, are made of one piece of mild steel, welded and supported by stay bolts.

In each boiler there are 81 weldless, drawn Mannesmann tubes, $3\frac{3}{4}$ in. external diameter and 16 ft. 4 in. long, between the headers, into which the tubes are expanded. The tube covers are of gun-metal, with taper metal to metal joints.

These boilers were supplied by the Technical and Commercial Corporation, Ltd., of Johannesburg, who are supplying a second set of the same make for the vertical shaft, and who kindly supplied the drawings reproduced in figs. 9, 10 and 11.

THE ENGINE ROOM.

Fig. 12 is a block plan, supplied by the courtesy of Mr. J. Pascoe and Mr. D. Cullen, the Company's engineer, showing the arrangement of the main engine room adjoining the mill, and containing the following machinery :—

One double drum winding engine for the normal working of the mine.

One single drum winding engine for sinking the shaft, without interfering with the raising of ore.

A crusher engine, capable of driving the mill in an emergency.

The mill engine

Two air compressors.

Two surface condensers.

Vertical engine driving a Siemen's three-phase generator of 150 kilowatts.

Two 6-ton overhead travellers, having a span of 52 ft., driven by hand.

The whole of the above plant, with the exception of the generator, has also been supplied by the Technical and Commercial Corporation.

THE DOUBLE-DRUM WINDING ENGINE.

This engine, built by the Wilhelmshütte Company, has two high-pressure cylinders, 19 in. in diameter by 49¼ in. stroke, working on to two cranks at right angles to each other. The crank shaft has bearings at the centre and at each end, and carries two loose drums, each 4 ft. wide and 8 ft. diameter. Each drum has a Webster camp and Lane clutch, but future engines of this make will be provided with a toothed clutch by means of which it can be fixed to the shaft in twenty-four different positions circumferentially, so that it can be shifted through 15 deg. or any multiple of that angle. The drums will take 3,600 ft. of rope $\frac{1}{16}$ in. in diameter. The engine is designed for a working boiler pressure of 150 lb., and will lift 80 cubic feet of broken rock in a skip weighing 4,000 lb. up an incline of 30 deg. This engine is shown in fig. 15.

The single drum sinking engine is of similar construction, with a pair of 17-in. cylinders and a drum, 8 ft. diameter by 5 ft. wide, taking 3,600 ft. of 1⅛ in. rope, and provided with a one-tooth clutch. It will haul 60 cubic feet of rock under the conditions given above.

THE KRAFT GEAR.

The chief feature of these winding engines is the Kraft valve gear, the general principles of which will be understood from the following brief description :—

The steam and exhaust valves are carried in valve chests bolted to the side of the cylinders, and are of the balanced double beat type. Each end of the cylinder is, of course, provided with a separate steam and exhaust valve, the latter being placed below the level of the inside of cylinder, which is thereby effectively drained.

There are a pair of cams for each valve, for the forward and backward running of the engine respectively. The cams for the steam valves are

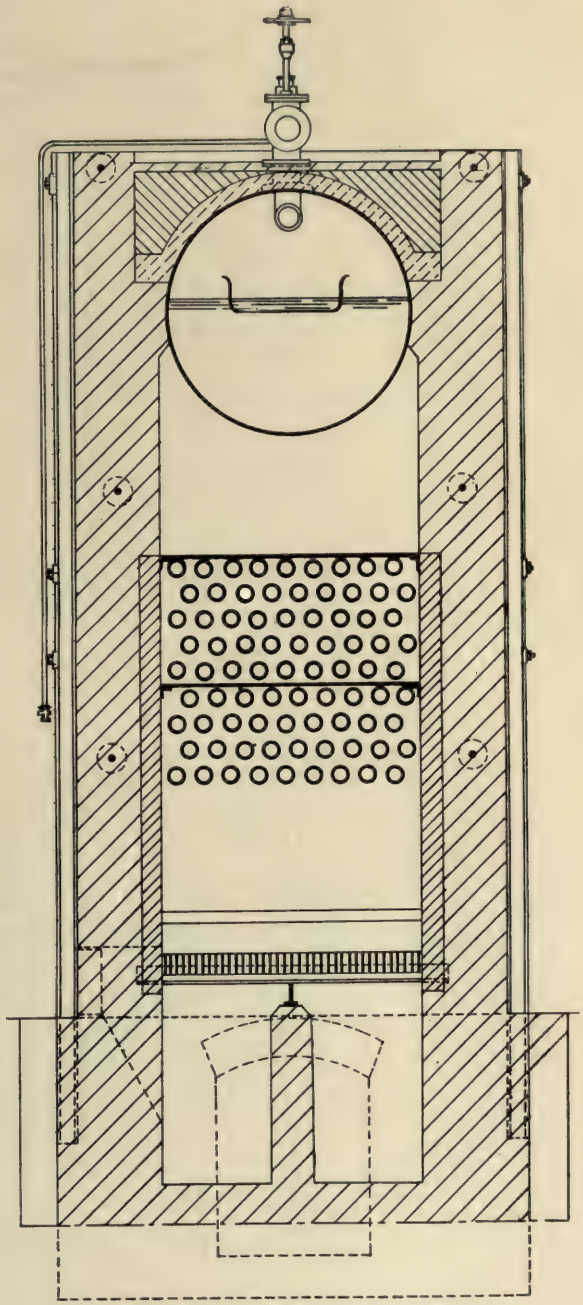


FIG. 11. BÜTTNER WATER-TUBE BOILER—TRANSVERSE SECTION.

constructed so as to give a variable time of closing according to the point in the length of the cam which is engaged, while on the other hand the exhaust cams give a constant opening and closing, no matter what point in their length is engaged with the valve lever. These cams

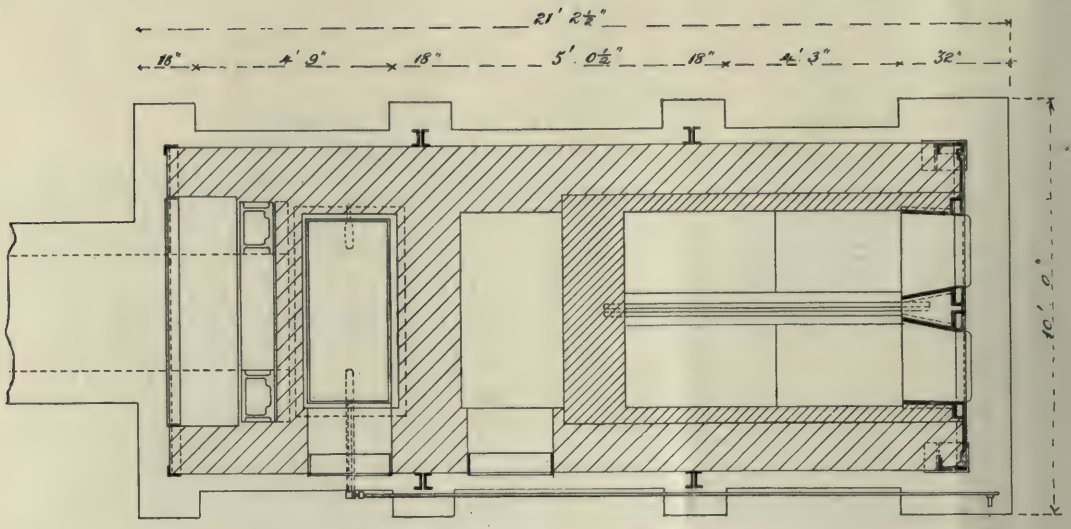


FIG. 10. BUTTNER WATER-TUBE BOILER—GROUND PLAN.

are attached to cylindrical shells and the engine is reversed by sliding these shells lengthwise on the side shaft (which supports and drives them) so that one or other of each pair engages with the valve levers. The variable cut-off is obtained in the same manner, that is to say, when the shells are at the centre of their longitudinal travel, neither cam engages the valve lever, while when they are at their extreme position at either end, the steam is admitted for 95 per cent. of the stroke, so that any required cut-off distance, from zero up to the above figure, can be obtained in the intermediate positions of the shells and cams.

The motion of the cams is transmitted to the valves by levers which carry hardened steel balls at their points of contact with the cam, and which are provided with adjustable springs to ensure a good contact pressure of the lever on the cam. The valve stems are fitted with dashpots. In order to prevent the steam and exhaust valves remaining open at the same time, owing to the valve stem packing being too light, or from any other cause, the Richter automatic gear is attached. This consists of a system of levers by the action of which the opening motion of the steam valve lever shuts the exhaust valve, and *vice versâ*, if either has remained open after being released by the cam.

THE RICHTER AUTOMATIC GEAR.

Another auxiliary attachment to this winding engine is the Richter gear for automatically

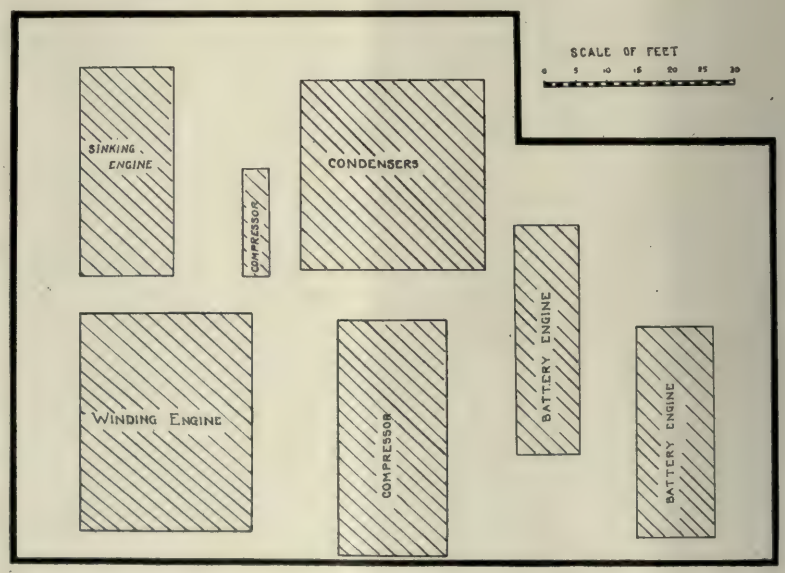


FIG. 12. PLAN SHOWING THE ARRANGEMENT OF THE MAIN ENGINE ROOM ADJOINING THE MILL.

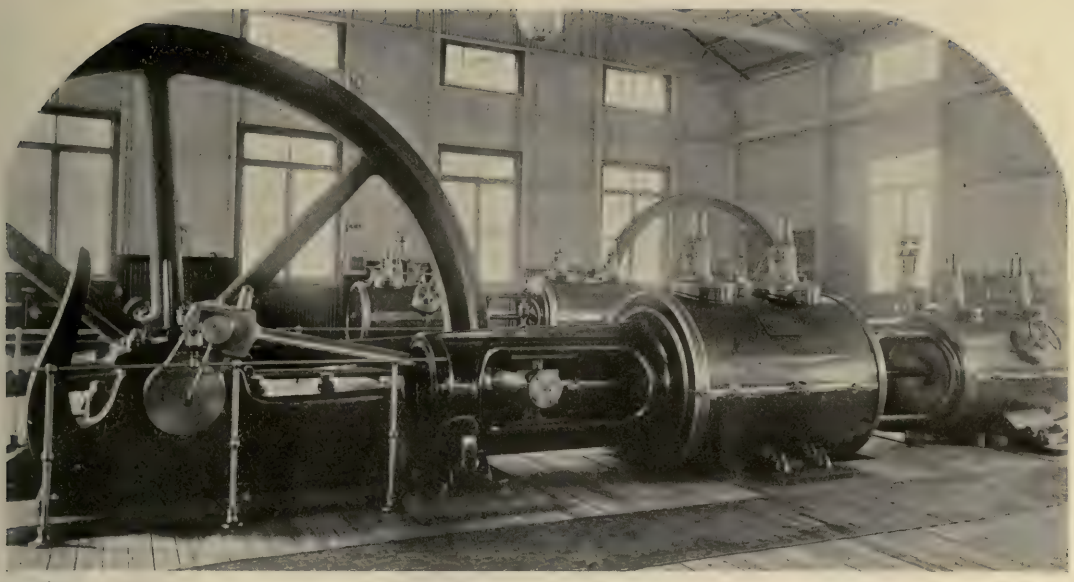


Photo by Author.]

FIG. 14. MAIN DRIVING ENGINE FOR MILL AT LANCASTER WEST MINE.

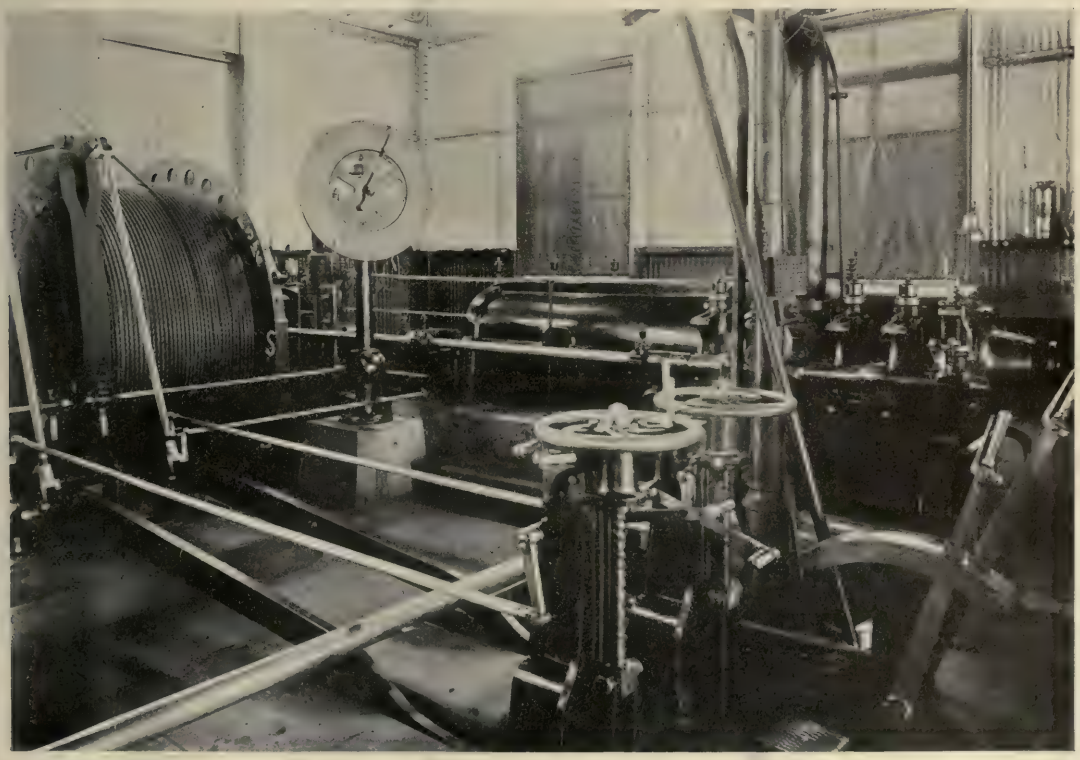


Photo by Author.]

FIG. 15. DOUBLE-DRUM WINDING ENGINE—LANCASTER WEST MINE.

shifting the point of cut-off as the load rises.

When the loaded skip is at the bottom of the shaft, the weight of the rope on that side is, of course, at its maximum, but as this skip rises and the empty one descends, the rope in the shaft on the down side increases in length and weight so that the actual load on the engine becomes continually less, and in a very deep shaft the loads might be quite balanced. The method employed for shortening the cut-off point as the load decreases is the following: On an extension of each cam shaft a fine thread is cut. On these threads there are nuts attached to levers which, as the shafts revolve, actuate a sector which is provided with a series of slots. When the automatic action is required, a catch on the reversing lever is dropped into one of these slots, and consequently the lever and the cams are moved automatically towards their central position as the loaded cage rises. The several slots in the sector are arranged for hauling from different levels, and the pitch of the screw may be designed to cut off steam altogether at any desired point, as, for instance, when the loaded skip arrives at the surface.

When this automatic gear is not required, the catch is simply lifted out of the slot, and the engine is then controlled in the usual way by the reversing lever.

All the parts of the valve gear are of case-hardened steel, the wheels being cut from the solid; the gear is designed to stand the strain of reversal at full speed and full steam, should this be necessary in an emergency.

DRIVING ENGINES.

The crusher and mill engines are of the usual tandem compound type, they were built by the Erste Brunner Machinen fabrik, and are fitted with the Collmann-Poppet valve gear. The principal dimensions of the two engines are:—

	Crusher Engine.	Mill Engine.
Indicated h.p.	160	250
High-pressure Cylinder, diam.	15¾ in.	18⅞ in.
Low-pressure Cylinder, ,,	23⅝ in.	29 5/16 in.
Stroke	31½ in.	35 7/16 in.
Revolutions per minute ..	80	70
Diameter of Flywheel ..	13 ft.	14 ft. 9in.
Number of Grooves for Driving Rope	7	10

20-DRILL AIR COMPRESSOR.

This, as usual, is of the cross-compound type, with steam cylinders (22 in. and 36⅜ in. diameter) at one end, and the air cylinders (19⅝ in. and 31⅞ in. diameter) at the other end of the bed. The stroke is 41¼ in., and maximum speed 66 revolutions per minute. The machine is capable of compressing 2,340 cubic feet of free air per minute to 82 lb. gauge pressure. The volumetric efficiency is said to be from 92 to 95 per cent., and the mechanical efficiency from 81 to 84 per cent. At 110 lb. steam pressure the engine develops 425 i.h.p., at 23 per cent. cut-off and 465 i.h.p. at 26 per cent. cut-off, and the steam consumption is given at 15½ lb. per i.h.p. per hour. The compression is fitted with the Koester valve gear, in which the suction valves are positively closed, and the delivery valves are spring loaded.

SURFACE CONDENSING PLANT.

This plant is in duplicate, one set being always in reserve. The air, water circulating, and force pumps are driven by an engine with a single cylinder, 10¼ in. diameter, with 12 9/16 in. stroke, averaging 55 revolutions per minute. The engine and pumps are arranged to work horizontally underneath the body of the condenser. The air and circulation pumps are 11¾ in. diameter, and the force pump 3 9/16 in. Each set has a condensing surface of 1,000 square feet.

ELECTRIC PLANT.

This includes an enclosed, vertical, three-cylinder compound Allen engine of 230 b.h.p. at 375 revolutions and 140 lb. steam pressure. The cylinders are 12 in., 21 in. and 21 in. respectively, with 9 in. stroke. The engine is directly connected by a Zodel insulated elastic coupling to the three-phase Siemen's generator, which, however, when necessary can be alternatively driven by rope gear from the mill engine. This is to provide against a breakdown, which would involve the stoppage of the electrically driven pumps in the mine.

EQUIPMENT OF VERTICAL SHAFT.

The winding engine, ordered for the permanent working of this shaft, is of the same design as those above described, but of larger size; the drums taking 3,000 ft. of 1½ in. rope.

There will also be a 40-drill air compressor of the type already mentioned.



THE TEMPERLEY TRANSPORTER

AT HOME AND ABROAD.

WE illustrate, by the courtesy of the Temperley Transporter Company, some recent examples of hoisting machinery for lifting and transporting materials. Fig. 2 shows two travelling tower transporters for discharging coal from vessels and depositing it through hatchways in the roof of a coal store at Trieste. They are arranged to run on one rail on the quay side and an elevated rail on the top of the coal store on the other side. The towers are in this case constructed of timber, and are warped into position by tackle.



FIG. 4. A COALING CRAFT WITH FOUR PORTABLE TRANSPORTERS.

These transporters are usually self-propelling, the whole of the machinery being contained within the structure.

In many transporters the structure carrying the elevated beam is built in bridge form, as in fig. 1, the piers being provided with wheels, carried on rails, along which the whole structure is propelled. The bridge transporter here shown was designed for use in the construction of a dock at Brest for loading excavated material into wagons. The total length of this transporter is 135 ft.; load, 35 cwts.; lifting speed, 300 ft.; transporting speed 600 ft.

Fig. 3 illustrates another form of transporter which has many useful applications. Radially pivoted, like ship's derricks, to a mast or some other suitable supporting structure, these play an important part where the space for a crane is limited, or the reach exceeds 40 ft. We have here a pair of radial transporters erected on a steel jetty for the Port Commissioners, Calcutta. They are fitted with single-purchase travellers for loads of 15 cwt., and worked by direct-acting transporter engines, the speed of lifting being 400–500 ft. per minute. These transporters are used for loading and unloading bales of jute and general merchandise.

Temperley transporters are used all over





FIG. 1. (THE UPPER VIEW) SHOWS A TRAVELLING BRIDGE TRANSPORTER USED FOR LOADING MATERIAL EXCAVATED FROM A DOCK AT BREST. IN FIG. 2 TRAVELLING TOWER TRANSPORTERS ARE SHOWN DISCHARGING COAL FROM VESSELS AT TRIESTE.



FIG. 3. A PAIR OF RADIAL TRANSPORTERS ERECTED ON STEEL JETTY, AT CALCUTTA, FOR HANDLING GENERAL MERCHANDISE.

the largest battleships or cruisers. The towers are made to travel the full length of the vessel, and thus command the whole of the hold.

For use on vessels, these transporters are made from 30 ft. to 65 ft. long, in multiples of five feet and for loads up to 30 cwt. The beams are provided at every five feet of their length with stops at which the traveller can be arrested at the will of the operator and the load lifted or lowered as required. An important consideration is that owing to the considerable over-reach, loads can be taken up or dropped at a distance of from 30 ft. to 40 ft. from the side of the vessel.

the world for the coaling of the war vessels or merchant steamers, and quite recently the Company have completed the equipment of two 1,000-ton coaling vessels, and a 12,000-ton floating coal depôt, with an output per hour up to between 600 and 700 tons of coal, in bags. Fig. 4 shows one of these vessels at work.

Fig. 5 shows a 1,000-ton coaling craft preparing to coal at Portsmouth. It is equipped with two self-contained Temperley travelling tower transporters, the beams of which have a very long overreach on both sides, and are high enough to take coal from a large collier and deliver direct over the boat deck of

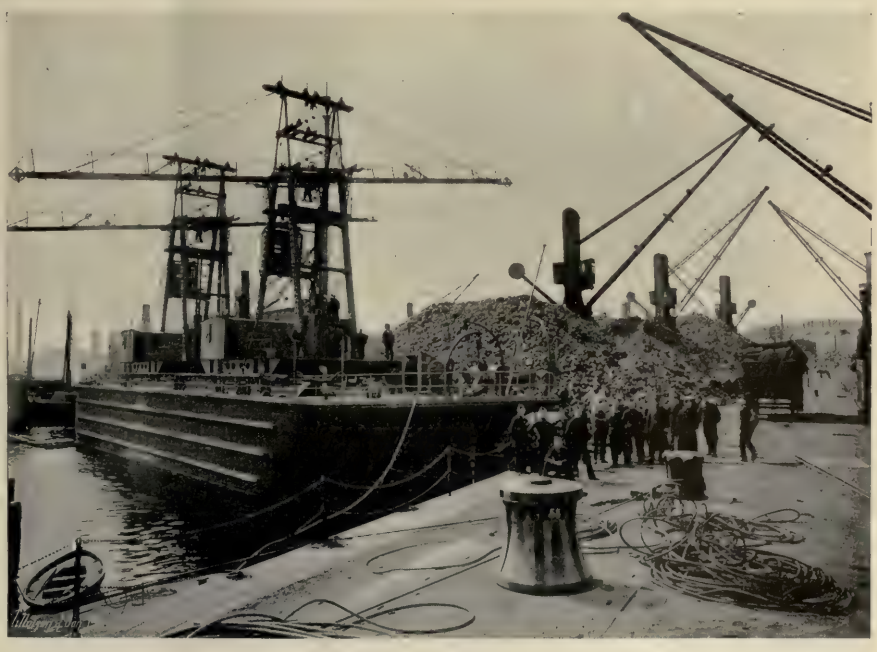
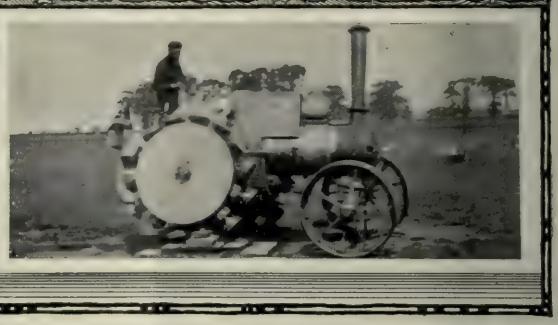


FIG. 5. A 1,000-TON COALING CRAFT PREPARING TO TAKE COAL ON BOARD.

THE PEDRAIL AND THE WAR OFFICE.



PRELIMINARY TRIAL OF THE 1904 TYPE.

AN interesting preliminary trial of Mr. Diplock's latest design of Pedrail engine (which he calls the Pedrail Tractor, 1904 type), recently took place at Lincoln, in the presence of three officers of the Mechanical Transport Committee of the War Office. After showing the movements of the Pedrail on rough ground, turning a quick circle, etc., it was attached to a lorry loaded with pig iron, the total weight of tractor and lorry being 9½ tons gross. This load was hauled for a distance of about four miles, in the neighbourhood of Lincoln, including a long hill, with an average gradient of 1 in 12, and in parts 1 in 8. The Pedrails throughout this trial worked with remarkable ease and certainty, and it was quite evident, in mounting the hill, that the adhesion of the Pedrails was sufficient for a much heavier load.

This conclusion was verified in a striking manner on the return to Messrs. Fosters' works at Lincoln, where the tractor was built. The tractor was attached to a traction engine, weighing 11½ tons, with the driving pin left in, so that, in hauling the engine, it was necessary to turn the gear wheels of the 11½-ton engine backwards, thereby adding very considerably to the resistance of the load. A dynamometer was placed between the tractor and load, and the average draw-bar pull registered was over one ton. The brake on the 11½-ton engine was then screwed down until the resistance on the draw-bar registered an average of just over two tons, at which point the resistance of the load proved sufficient to pull up the tractor. It may be mentioned, for the benefit of the uninitiated, that on a first-class, hard, level road (taking road resistance at 60 lb. per ton), a draw-bar pull of two tons is equivalent to pulling a load of about 75 tons.

The interesting feature of this trial lies in the fact that the tractor was pulled up by want of sufficient cylinder power in the engine, and not by want of adhesion. Throughout the trials, the Pedrails never skidded or slipped, and this, notwithstanding that the heaviest trial took place on ground with a loosened upper surface about two inches thick in dust.

The officers present were Major Lindsay Lloyd, Major Donohue, and Major McNalty. The accompanying illustrations are from photographs taken by our own representative.

Professor Hele-Shaw has, from the first, expressed his firm belief in the great future that awaits this invention, and recent experiments go far to prove the correctness of his forecast.

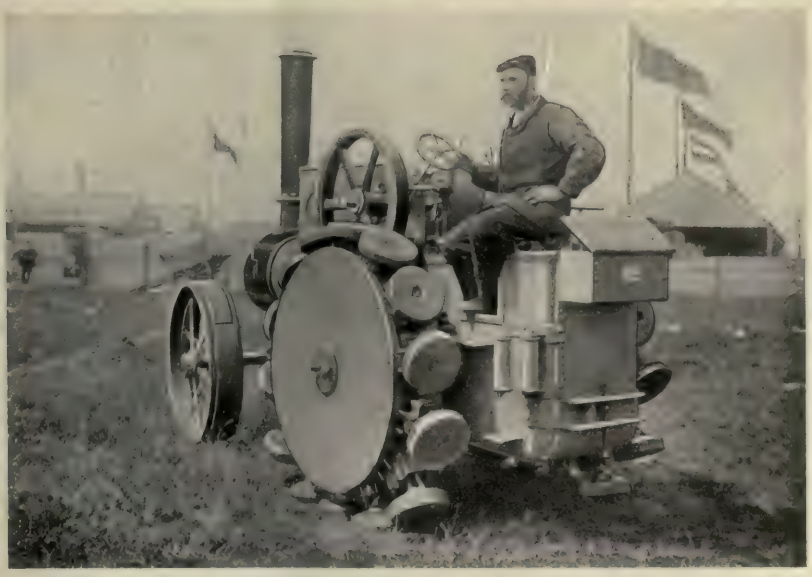
Mr. Diplock is now fitting this same tractor with double cylinders to increase the power, and, as soon as this is done, further War Office trials will take place—probably in the Long Valley, Aldershot.

DETAILS OF THE LATEST PEDRAIL.

A description of the Pedrail, with illustrations, will be found in PAGE'S MAGAZINE for January, 1904. The following particulars of the 1904 type of Pedrail tractor are extracted from the latest specification :—

The Pedrail tractor, 1904 type, is a small, specially designed traction engine of the ordinary type, fitted with two Pedrails for driving, two ordinary wide-tyred engine-wheels for steering, and weighing complete about five tons.





THE PEDRAIL TRACTOR, 1904 TYPE.

It is designed so as to bring about four tons on to the road through the Pedrails, and one ton through the steering wheels. Experience has gone to prove that ordinary wheels, with 9-in. width of tyre and a 5-in. band riveted on the tyre, will, if not loaded with more than one ton per pair, afford satisfactory steering results, even on soft ground.

The Pedrails on the hind axle are of Mr. Diplock's latest design, embodying all the improvements attained by several years of practical experiment. The Pedrails are 5 ft. in diameter, each with fourteen spokes and feet.

The feet or peds are 11 in. in diameter on tread, and soled with rubber in eight segments, with strips of wood between the segments to prevent suction in clay soil. The segments are held together by a malleable cast-iron ring around the periphery of the feet and a tightening cone in the centre. These wearing parts, being separate from the rest of the foot, are easy and cheap to renew, and repairs can be quickly effected, if necessary, when on the road. The surface in contact with the ground being composed of the three substances, metal, wood, and rubber, which all take a bearing, provides a combination of materials adapted to the best adhesion and wear on any class of road, or even on no road at all. The area of each foot is 95 square inches.

The ball-and-socket movements of the feet and their outer shell are of steel. The neck of the ankle joint is also of steel, and of sufficient strength to withstand very rough usage and wear. The sole of the foot is screwed into the upper shoe, the screw affording a means of taking up wear in the ball and socket and other moving parts of the foot.

The railway levers and rail side cams are all of steel, and the rail itself is a steel casting of the very best tempered steel, and can be replaced in a few hours by a spare rail when necessary. All the revolving portions are bushed with gunmetal.

The outsides of the discs are completely covered in with sheet-iron covers, which can be readily removed when on the road, in order to get at the internal parts.

The ankles of the feet are protected by crustacean joints of copper, which can be renewed at small cost when badly worn, and are provided with an elastic spring collar on top to automatically take up wear and render them noiseless.

The feet are lubricated by being filled internally with a mixture of blacklead and grease of suitable quality, which only requires renewal at long intervals. The sliding spokes, rollers, and friction-clutches are all lubricated from one central oil-chamber, through a beautiful system of oil-tubes, which provide a circulation of the oil throughout all the moving parts. The central oil-chamber is filled from one orifice, and holds a sufficient supply of oil for a long journey.

GENERAL DIMENSIONS OF THE PEDRAIL TRACTOR, 1904 TYPE.

Diameter of cylinder	6 in.
Stroke of piston	9 in.
Revolutions of crankshaft per minute..	300
Diameter of Pedrail	5 ft.
Number of peds to each Pedrail	14
Diameter of each ped	11 in.
Diameter of fore wheels	3 ft. 8 in.
Width of fore wheels ..	9 in. & 5 in. bands
Diameter of fly wheel ..	2 ft. 8 in.
Width of fly wheel ..	$3\frac{1}{2}$ in.
Diameter of crankshaft.. ..	$2\frac{1}{2}$ in.
Total width over Pedrails	5 ft. 7 in.
Total length	11 ft. 6 in.
Total weight, without water or coal	about 4 tons

As regards the future of the invention, the feature of greatest importance lies in the fact that, as the Pedrails are enlarged, the area of the peds increases in the ratio of the square of their diameter; and thus, by extending in strong skeleton form the diameter of the Pedrails and peds, the floating or supporting area can be enlarged altogether out of proportion to the increase in total weight of the vehicle or engine.



A FRENCH CRUISER IN DRY DOCK.



FRENCH NAVAL BALLOON UNDERGOING ITS TRIALS.



ONE OF THE LOCOMOTIVES.



A PASSENGER CAR.

THE LEEK AND MANIFOLD LIGHT RAILWAY.

A description of the new line, and a brief account of its inauguration,

BY

ARMISTEAD CAY.

Recently opened in North Staffordshire, this railway has been designed by Mr. Everard R. Calthrop, M.Inst.C.E., M.I.Mech.E., on plans which have proved financially successful in India. The rolling stock and the method of transporting broad gauge vehicles over narrow gauge lines, and *vice versâ*, are worthy of special attention, while the whole scheme is an instructive object lesson showing what may be done to open up thinly inhabited districts in this country. The article is illustrated with numerous photographs specially taken for PAGE'S MAGAZINE.—ED.

THE opening of the Leek and Manifold Light Railway marks the introduction of a system of light railway construction which has been very successfully used in India, and also in the Barbadoes, for the development of country which is too thinly inhabited to render an ordinary railway remunerative. It is in this respect primarily interesting to readers of PAGE'S MAGAZINE. To the people of the Manifold Valley it means a great deal more, for they, not unnaturally, regard the railway as the harbinger of a new era of prosperity. Before proceeding to describe the new line and its formal opening by the Earl of Dartmouth last month, it will be well to briefly consider the *locus in quo*.

WHERE IS THE MANIFOLD VALLEY?

Everybody has heard of Dove Dale, but the Manifold Valley which, roughly speaking, may be said to be parallel with it, is to most people a *terra incognita*. Thanks to the light railway, thousands of excursionists will become acquainted with what is undoubtedly some of the finest scenery in North Staffordshire. The local farmers will be able to send in their produce at remunerative rates, and it is not altogether improbable that the copper mine at Ecton, one of the deepest in this country, may again add its quota of metal to the market.

The line traverses a district rich in minerals. It is to form a feeder line for the North Staffordshire Railway, but unfortunately, the

branch of that railway between Leek and Waterhouses, with which it is to be connected, is not yet completed. In the meantime, a motor-car service has been established between these places.

Waterhouses, the terminus of the light railway, is situated about midway between the town of Leek, which is upon the North Staffordshire Railway, and Ashbourne on the London and North-Western Railway. From Waterhouses the light railway extends in a northerly direction following the valley of the rivers Hamps and Manifold for a distance of 8¼ miles, and terminating at Hulme End, which is situated on the high road between Leek and Hartington Stations on the London and North-Western Railway.

It will be obvious by a glance at the map of this district, that the ultimate objective of the railway must be Buxton, and it is understood that the Light Railway Company intend to apply for powers immediately to construct this extension. Mr. Calthrop, the constructing engineer for the Light Railway Company, having already ridden over the ground, and mapped out a route which presents no great engineering difficulties, it is probable that more will be heard of the matter at an early date. The surrounding country presents all the features which make light railway enterprises desirable and place broad-gauge lines at a discount. For instance, from Leek to Buxton by road is about twelve miles; by rail it is something over thirty.

THE PERMANENT WAY.

The Leek and Manifold Light Railway has been designed and completely equipped by Mr. E. R. Calthrop, M.Inst.C.E., M.Inst.M.E., of 3, Crosby Square, London, E.C. The construction of the permanent way under the supervision of Mr. J. B. Earle (resident engineer), has cost that gentleman some 8,000 miles of peregrination, to say nothing of professional skill.

Mr. Calthrop has started from the premises of an axle load of five tons and a 2-ft. 6-in. gauge. In conducting the survey he has obviously taken every advantage afforded by the conformation of the country, and this combined with the great flexibility of alignment afforded by the 2-ft. 6-in. gauge has enabled the railway to be constructed with a minimum amount of cuttings and embankments. The weight of the rail is 35 lb. per yard. The minimum curve is four chains, the maximum gradient being 1 in 40. The bridges, as will be seen from the accompanying illustration, are of a simple character and in only one case was it found necessary to construct a short tunnel, this being undertaken in order not to disfigure Sir Thomas Wardle's picturesque property at Swainsley.

ROLLING STOCK.

The greatest interest of the new line undoubtedly centres in the rolling stock and its adaptability for varying conditions of work. It is on similar lines (subject to various improvements), to the stock which Mr. Calthrop designed for the Barsi Light Railway in India. By adopting a uniform axle load of five tons throughout, Mr. Calthrop has been able to reduce the weight of rail, and wear of permanent way to a minimum, and at the same time he has combined a maximum carrying capacity with a minimum tare weight. While the vehicle units have the same high traffic capacity as on the Barsi Light Railway, the traffic on this railway does not demand the heavy trains now carried on the former, which in ordinary working is hauling trainloads of 300 tons, and is carrying, train for train, the same weight of goods as the 5 ft. 6 in. gauge Great Indian Peninsula Railway.

The construction of the rolling stock was carried out under the supervision of Mr. E. Godfrey Brewer, assistant mechanical engineer, and Mr. Calthrop, to whose courtesy the writer is chiefly indebted for the information contained in this article.

The rolling stock on the Leek and Manifold Light Railway is much larger than any that has been put on a 2-ft. 6-in. gauge in Great Britain, and special sanction was obtained from the Board of Trade for the dimensions desired by Mr. Calthrop. The single tunnel is of such a size that not only is it capable of giving ample clearance to the very large coaches which are on the railway, but by means of the transportation cars which are referred to later, vehicles with the largest



Photo by Elliott and Fry.]

MR. EVERARD R. CALTHROP, M.INST.C.E., M.I.MECH.E.

Designer and Chief Engineer of the line.



GENERAL VIEW OF THE TERMINUS AT HULME END, DECORATED FOR THE OPENING.

cross sectional dimensions now on the North Staffordshire Railway can be conveyed over the new line.

To engineers accustomed only to English railways, the rolling stock would appear to be of an abnormal size for a railway of only 2-ft. 6-in. gauge, but experience in India and the West Indies has proved, after seven years' constant work, that it is absolutely safe, and, in fact, would be so even were they slightly larger in cross-sectional dimensions. Any doubts as to the stability of the coaches are immediately dispelled after riding in them. They travel so smoothly, that when once inside and travelling one might well imagine oneself in a corridor coach on one of the main



ENGINE AND LOW-SIDE WAGON, THE LATTER WITH TEMPORARY SEATS FOR VISITORS.



A VIEW OF THE LINE AT WATERHOUSES.

The track shown on the left-hand side of the picture communicates with the broad gauge line to Leek, now in course of construction.



GRINDON STATION.

One of the most picturesque stopping-places on the line.

line English railways. Before the opening ceremony, these coaches were tested at a speed of 30 miles per hour over the entire railway. They are being run for daily service at a speed of 12 miles an hour.

THE COACHES.

The coaches are 42 ft. long over the headstocks, 8 ft. wide over all, 6 ft. 9 in. wide inside, and 10 ft. high from rail level to top of roof, giving 6 ft. 6 in. head room at the lowest point inside. It will be noted that these dimensions are very little less than the dimensions of a modern main line English railway coach, and are far greater than those of a large number of coaches still in use on standard gauge railways in this country. The coaches are of two types, namely, composite first, third, and guard's compartment, and third class coaches. The composite coaches are provided with seats for 22 third class passengers, and 8 first class. The third class coaches have seating accommodation for 44 passengers. Besides this seating accommodation both types of coaches are provided with large railed outside platforms, upon which passengers are allowed to travel for the purpose of viewing the scenery, but it is only fair to mention that the coaches are provided with large plate glass windows.

The coaches are fitted with Stone's patent system of electric lighting, and all the rolling stock is fitted with the automatic Vacuum Brake Company's vacuum brakes. The handsome ornamental ventilator glasses in the first and third class coaches were made by Messrs. Morris and Sons, of 239, Kennington Road, London, S.E. The wheels have been supplied by Messrs. The British Griffin Chilled Iron and Steel Company, of Barrow-in-Furness. The coaches were built by Messrs. The Electric Railway and Tramway Carriage Works, Ltd., of Preston, and as previously stated, to the designs of Mr. Calthrop.

ENGINES.

The locomotives are a modification of those which have given so much satisfaction on the Barsi Light Railway, which were built by Messrs. Kitson and Co., of Leeds, to Mr. Calthrop's designs. They are six-wheel coupled, having driving wheels 2 ft. 6 in. diameter, with a rigid wheel base of only 6 ft. They have outside cylinders 11½ in. diameter by 16 in. stroke, with a boiler pressure of 150 lb. per square inch. The principal difference between these locomotives (which were also built by Messrs. Kitson and Co.), and those on the Barsi Light Railway, is that the Barsi engines were eight-wheel coupled, with cylinders 13 in. diameter by 18 in. stroke, whereas in these engines for the Leek Railway the size of the cylinders has been reduced and the leading pair of driving wheels have been replaced by a two wheel radial bogie, the engines therefore being less powerful. The leading bogie enables them to run round the very sharp curves which are used on this line, and also by a suitable spring device relieves the leading driving wheel flanges from the excessive strain caused by turning the weight of the engine when either leaving or entering a curve. This work is transferred from the flanges of the leading driving wheels to those of the leading bogie gradually, as the springs are compressed. The directors of the Light Railway Company, desiring to perpetuate the memory of their engineers, have paid them the unusual compliment of naming the engines after them.

TRANSPORTATION SYSTEM.

The most novel feature on the railway is Mr. Calthrop's patent transportation car. This, as previously stated, is for carrying standard gauge railway vehicles over the narrow gauge railway, thereby retaining all the advantages of the narrow gauge without the disadvantages and cost of transhipping goods. The bogies of these vehicles, together with all other kindred parts, are entirely enclosed by the body of the vehicle, which has been kept as low as possible. From the lower edges of the body extending outwards on either side are two platforms, each being about 18 in. wide. Where these platforms join on to the sides of the vehicle, they are constructed with slots formed of a shallow inverted channel iron, which slots serve as the rail to receive the wheels of the standard gauge vehicle, these rails being situated only 10 in. above the surface of the narrow gauge rails.

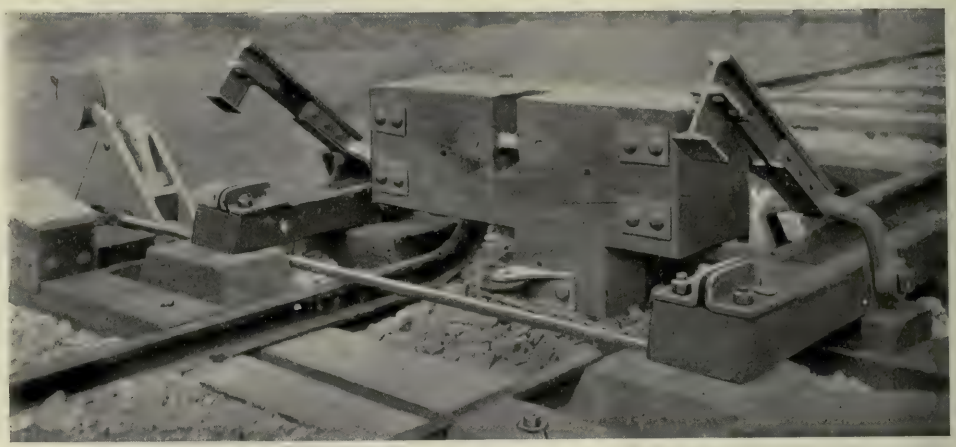
A most ingenious buffer stop or transfer

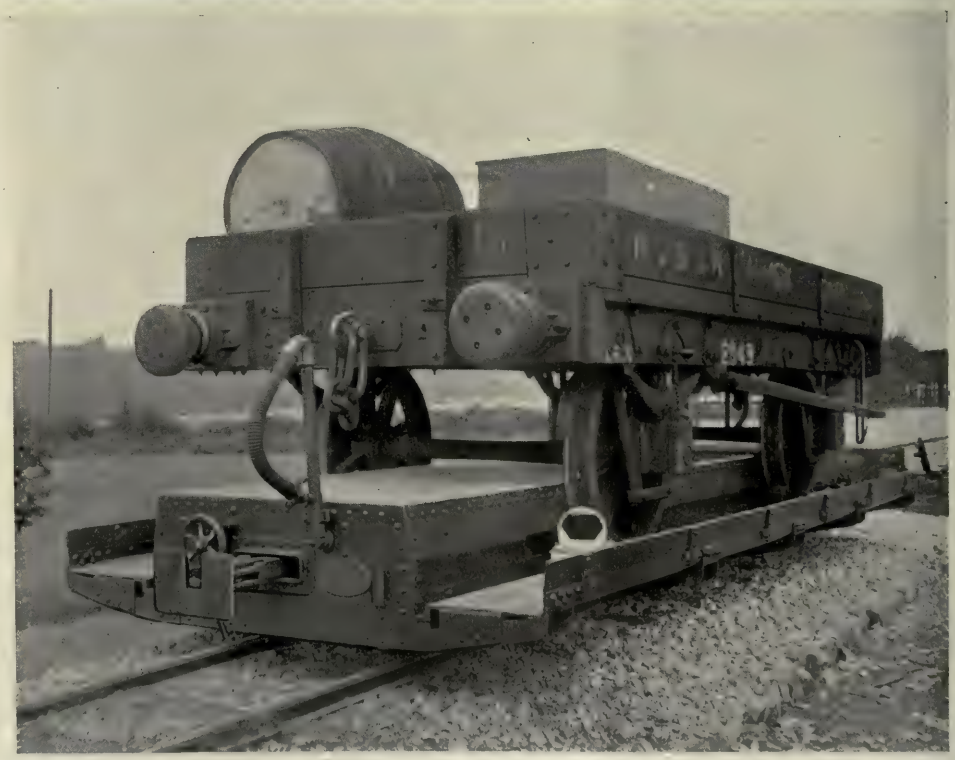




OTHER VIEWS EN ROUTE.

The upper photo shows a typical bridge ; below is a characteristic curve. Both these views also serve to portray the character of the scenery which becomes more and more romantic as the line proceeds. There is not one quarter-mile of continuous straight line in the whole railway.





TRANSPORTATION MECHANISM AND TRUCK.

The lower view shows a transportation truck running on the narrow gauge line, and bearing a standard gauge wagon. The mechanism by which the transfer is effected is shown above.



MR. JOHN B. EARLE.
Resident Engineer.

mechanism, which in spite of its extreme simplicity fulfils all the duties required of it in the most satisfactory manner was shown working to a large number of interested spectators; it has been designed and patented by Mr. Calthrop, its object being to transfer the standard gauge vehicles from their sidings on to the transportation car. In transferring a standard gauge vehicle from its fixed road to its movable one on the transportation car, all that is required is to run the transportation car up against the stop block; a lever is then pulled over which securely fixes the car in place, the vacuum brake pipe is lowered, and the vehicle is then run on to the car by hand and is secured by means of screw wedges placed beneath its wheels, the lever is then returned to its first position, and the car is ready to transport the standard gauge vehicle over the narrow gauge road. This operation (see illustration), is a most simple matter, and it was performed by two men in slightly under two minutes, although everything was new and some of the parts still required some further slight adjustments. The transportation car, together with its loaded standard-gauge four-wheeled wagon on board, was attached to the special train which had conveyed the opening party from Waterhouses to Hulme End on its return journey, and although the 8¼ miles were covered in 40 minutes, it rode with the greatest ease and safety around the very sharp curves on the line. All the wagon sidings on the railway are of standard (4 ft. 8½ in.) gauge, so that, as regards goods traffic exchanged with the main line, the railway is, to all intents and purposes, a standard gauge railway. The narrow gauge wagons are intended for local traffic and maintenance purposes only.

There should be a great future for this class of vehicle, as it undoubtedly removes the hitherto great objection to narrow gauge railways as feeders to railways of standard gauge. The transportation wagon is also capable of being used for numerous other purposes, namely, carrying long timber,



MR. E. GODFREY BREWER, A.M.INST.C.E., A.M.I.MECH.E.
Mechanical Engineer.



BRIDGE AT WATERHOUSES.

End of the standard gauge railway, showing temporary narrow gauge track communicating with contractor's temporary standard gauge railway. The village of Waterhouses is seen through the arch.

by means of swivelling bolsters, carrying milk cans, road vehicles, or any large and bulky article which is usually conveyed on a crocodile truck. This transportation car was built by Messrs. Cravens, Ltd., of Sheffield, and it is understood that as soon as this first car has been thoroughly tested by the engineers, orders will be placed for five more cars of this description.

WAGONS.

Two low side bogie goods wagons were also in use on the opening day with temporary seats attached to them, and many who travelled on these remarked that they rode almost as well as the coaches. They are built of pressed steel by the Leeds Forge Company, Ltd., of Leeds, and are exact duplicates of those which have been working for the past seven years with every success on the Barsi Light Railway. They are capable of carrying a load of 14½ tons, the weight being 5½ tons, including vacuum brake gear.

GOVERNMENT INSPECTION.

The Board of Trade inspection was made about a week previous to the opening by Major Druett, who passed the line as being in perfect working order, and was emphatic in his praise of what had been accomplished by the engineers. The engines and rolling stock, he considered admirably suited to the character of the requirements, and his remarks generally were of a highly congratulatory nature. The Leek and Manifold Valley Light Railway has involved a cost of £55,000. This has been met as follows: Subscribed Capital, £20,000; County Council Loan, £10,000; Treasury Grant, £25,000.

OFFICIAL OPENING OF THE LINE.

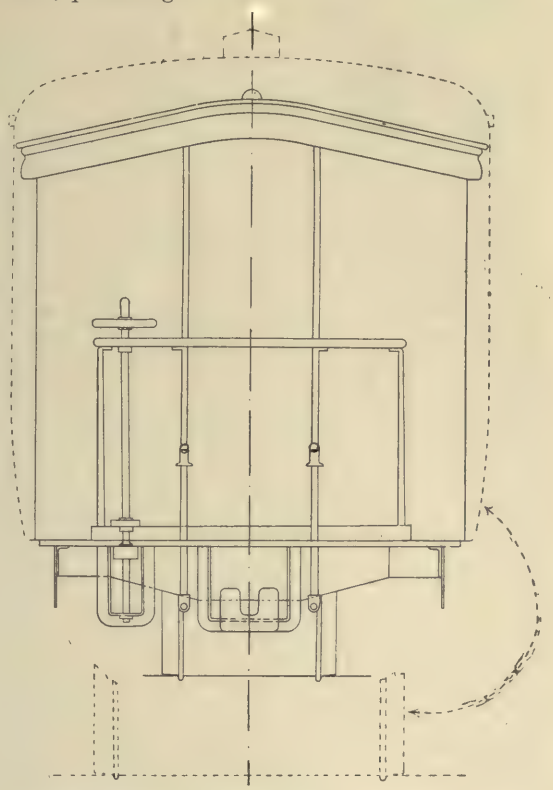
A significant feature, showing the attitude of the district to the new line was to be found in the floral decorations at Waterhouses, which were very extensive and included some half-dozen triumphal arches with inscriptions welcoming those who were to take

part in the inauguration and wishing success to the railway.

Among those present besides the Earl of Dartmouth, Lord Lieutenant of the County, who opened the line, were Mr. Charles Bill, M.P., Chairman of the Light Railway Company; Colonel Boughey, one of the Light Railway Commissioners; Sir A. P. Heywood; Sir Thomas Wardle; Mr. Tonman Mosley, Chairman of the North Staffordshire Railway; Dr. Alfred Hall; Mr. A. J. Hambleton; Mr. J. W. Bassett; Mr. A. Morton; Mr. J. P. Sheldon, all directors of the Light Railway Company; Miss Heywood; Mr. A. H. Moore; Mr. W. D. Phillipps, General Manager of the North Staffordshire Railway; Mr. G. J. Crosbie Dawson, Engineer of the North Staffordshire Railway; Mr. E. Challinor, Secretary of the Light Railway Company; Mr. R. E. Pearce, Secretary of the North Staffordshire Railway; Mr. E. R. Calthrop, the Constructing Engineer; Mrs. Calthrop; Mr. John B. Earle, Resident Engineer to the Light Railway Company; Mr. E. Godfrey Brewer, Assistant Mechanical Engineer to Mr. E. R. Calthrop; Mr. W. H. Hutchinson, Contractor for the Light Railway Company; Mr. Trim, Outdoor Assistant to the General Manager of the North Staffordshire Railway; Mr. T. P. Reay, Managing Director of Messrs. Kitson and Co., Ltd., Leeds; Mr. Francis L. Lane, of the Leeds Forge Company; Mr. George Whale, Locomotive Superintendent of the London and North-Western Railway; Mr. J. R. Dix, General Manager, Corris Railway, Merionethshire; Mr. W. B. Wright, General Traffic Manager of the Southern Mahratta Railway, India; Mr. L. Pickin, Secretary of the Electric Railway and Tramway Carriage Works, Ltd., Preston; Mr. R. E. Churchill Shann and Mr. Ernesto Marty, who is now in England reporting to the Argentine Government on railway matters. The Portuguese Minister of Railways and suite travelled down to Stoke with the intention of being present at the opening, but were unfortunately recalled, and had to leave London for Lisbon on the opening day.

The Earl of Dartmouth, speaking from the steps of a saloon, formally opened the line, in the following terms: "I declare the Leek and Manifold Valley Light Railway open for traffic with the most ardent hope that its success may exceed the wishes of the most sanguine supporters." The party then left Waterhouses for a tour of the line, the train being watched with much interest by crowds at the various stations, and at Hulme End a short stoppage was made in order to give the visitors an opportunity of examining the arrangements for transport, etc., as above described.

On returning to Waterhouses the party, at the invitation of the Chairman and Directors, lunched in a large marquee, Mr. Charles Bill, M.P., presiding.



Sectional drawing showing the comparative dimensions of the light railway cars and those of the North Staffordshire Railway, the latter indicated by the dotted lines.

A Large Hydraulic Press

For the Indian Government.

WE illustrate, on this and the following pages, a flanging and bending-press, intended for use in the Jubalpur gun-carriage factory of the Indian Government, and made by the West Hydraulic Engineering Company, 23, College-hill, London, E.C. This press is of some interest, on account of the great range of powers available, and the special water-saving arrangements which have been designed to effect a very considerable economy in the consumption of water under accumulator pressure.

Owing to the comparatively small number of gun-carriages turned out per annum, and to the great number of different parts required in each carriage, together with the fact that there are seldom more than one or two identical components in the completed carriage, it would be financially impossible to make each part in a press specially designed for the rapid manufacture of that one article. Instead of having several presses of varying powers, which would probably be standing idle for twenty-three out of the twenty-four hours, it is advisable to have a press, similar to that which forms the subject of this article, in which any required power can be exerted, ranging from 30 to 1,000 tons, and at the same time only consuming as much water as would be required in a special press of the required power, fitted with the usual water-saving valves. From fig. 1, which shows a general view of the press in the maker's erecting-shops, and fig. 3, which gives a very good perspective view of the main valves and piping arrangements, it will be seen that the power is derived from three main rams, which can be used either one, two, or altogether, as desired, the return of the crosshead being erected by two differential rams. This is a very convenient arrangement, in shops of sufficient height, as it obviates the necessity of either inside packings, or the small crossheads and tiebars, which are otherwise required.

Fig. 2 shows the special form of intensifier, which the West Hydraulic Engineering Company have designed to give a continuous flow of intensified pressure, as long as the foot-valve is depressed. This intensifier is actually an hydraulic-power pump, and will increase the accumulator pressure 1,000 lb. to 3,400 lb. per square inch, if the smaller rams are fed from low-pressure supply, or a pressure exceeding 5,000 lb. per square inch, if the suction valves are connected up to the 1,000 lb. mains. The action of the water-saving arrangement is as follows: Assuming that the dies are on the table, and that the work is placed on the dies, the three valves open all five cylinders of the press to exhaust. The crosshead falls by its own weight, and the three main cylinders draw in water from the exhaust tank mounted on the entablature of the press. If the centre ram is then opened to the 1,000 lb. pressure, a power of 60 tons is exerted by the press. If the two outside rams only are used, the power is then 120 tons, or 180 tons. When all three are open to pressure, the intensifier may then be turned on to raise this pressure to either

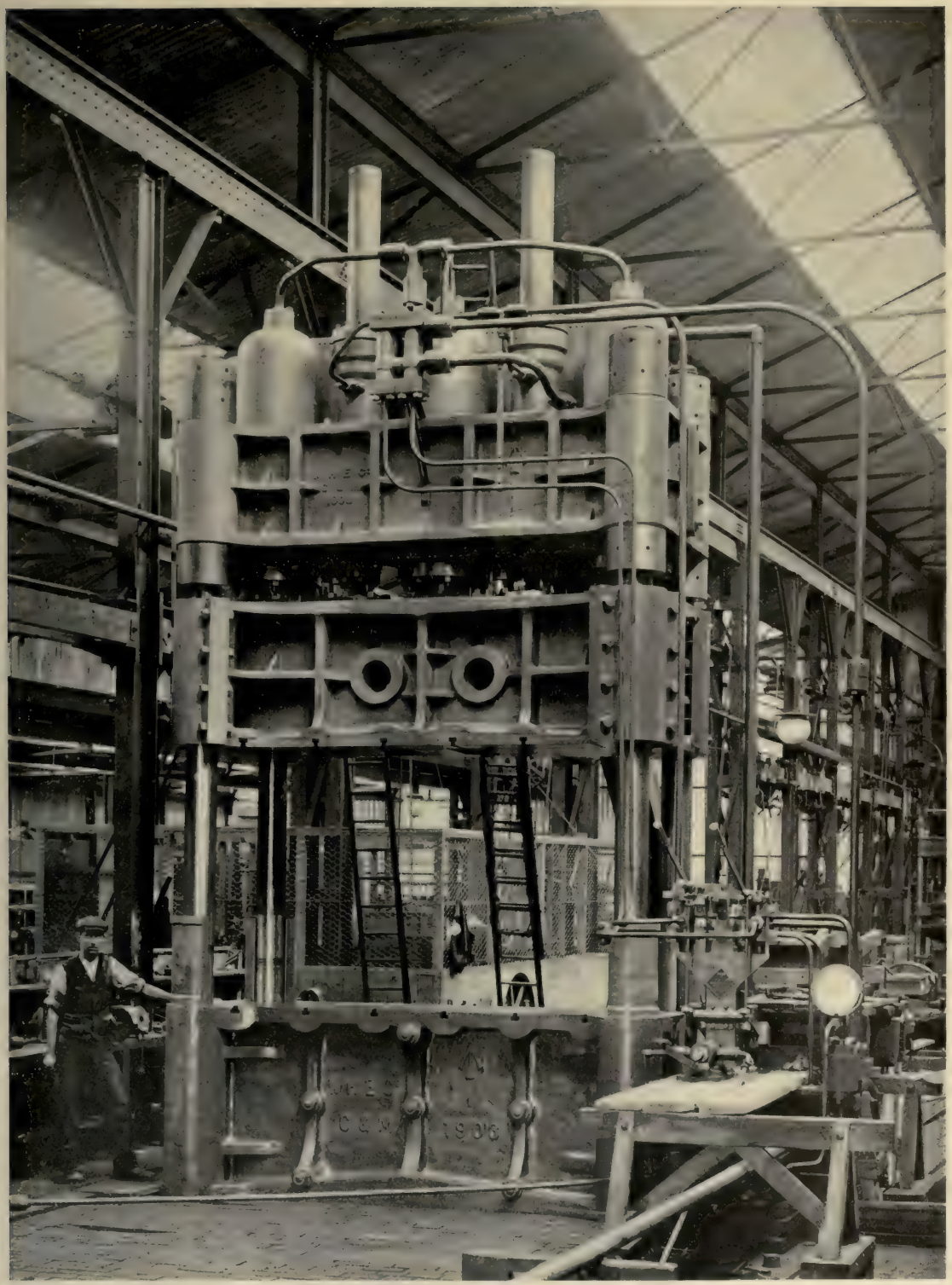


FIG. I. A GENERAL VIEW OF THE PRESS.

200, 400, or 600 tons. Or, if the accumulator is connected to the mains, in the manner stated above, the powers are raised to 330, 660, and

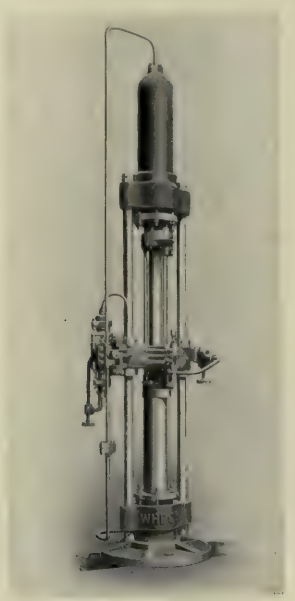


FIG. 2. SPECIAL FORM OF INTENSIFIER.

990 tons. For very light work, the centre ram can be used at the 1,000 lb. pressure, and if the return rams are also opened to pressure, the power would then be only slightly in excess of 30 tons. For effecting the return stroke of the crosshead, stripping powers of 30, 100, or 150 tons can be employed. During this return stroke, the three main cylinders empty themselves into the exhaust-tank, which discharges into the return main only as many gallons of water as have been taken from the mains for the actual pressing portion of stroke.

The valve arrangement is extremely simple—three levers and a foot-valve sufficing for the whole of the movements. The valve on the top of the press, which controls the admission for exhaust to and from the main cylinders, is in duplicate: one part serving to control the centre cylinder, the other part being connected to the two outside cylinders. This valve is operated by fluid-pressure, and connected up to two small pilot-valves. The drawback rams are actuated by a mitre-valve of special construction; and as all the valves are balanced, and the weight of the levers counter-balanced, the press can be used for planishing at a speed of 40 to 60 short strokes per minute.

A very good idea of the massive proportions of the press can be obtained from fig. 1, which shows a man at the left-hand bottom corner. The actual net weight of the press and intensifier is 68 tons. The somewhat distorted view, shown in fig. 3, is due to the fact that the photograph was taken from the bridge of the overhead electric traveller, and it was necessary to point the camera downwards beyond the limits of correction of the swing-back.

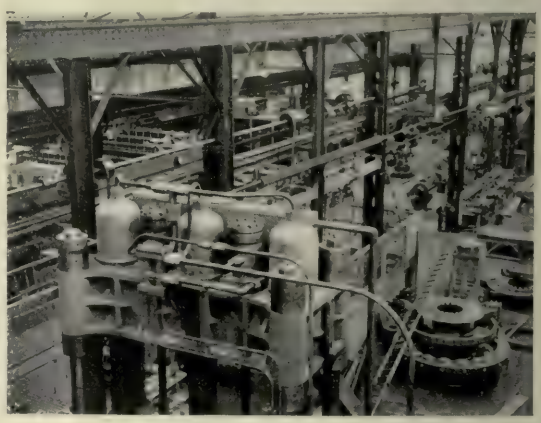


FIG. 3. MAIN VALVES AND PIPING ARRANGEMENTS.



FIG. I. THE HYDRAULIC DREDGE, "J. ISRAEL TARTE."

THE DREDGING OF THE ST. LAWRENCE SHIP-CHANNEL.

An Account of the Hydraulic Dredge "J. Israel Tarte."

BY

A. W. ROBINSON, M.CAN.SOC.C.E.*

Here we have an instructive example of colonial enterprise. The dredge described is not only of Canadian design, but it is wholly a Canadian construction. "The entire dredge," writes the author, "including steel hull, boilers, engines, pump and discharge pipe was built at the Polson Iron Works, Toronto, in the short space of eight months, though no similar dredge had ever existed before. The builders did not possess a single pattern that was applicable, nor had they any previous experience in building dredges." The fact remains that this dredge holds the world's record for performance.—ED.

THE hydraulic dredge, *J. Israel Tarte*, was placed in service in June, 1902, in deepening the channel through Lake St. Peter in the River St. Lawrence. As it involves some new features both in design and mode of operation, and has achieved a remarkable result, a detailed account of the dredge and of the work on which it is engaged will be of interest.

The Lake St. Peter Channel is part of the improvement in navigation of the River St. Lawrence between Montreal and Quebec. This work has for its aim the passage of ocean vessels to Montreal, making that city the point of transhipment of the inland lake and rail traffic by the St. Lawrence route to the sea.

The fact that this great work was commenced in 1832, and prosecuted with more or less continuity ever since, is eloquent testimony alike to the importance of the work and to the energy, pluck and perseverance of those early pioneers who so boldly faced a work of such stupendous magnitude with the primitive appliances and slender financial resources which they then possessed. It is indeed a fortunate fact that all this early work still remains to the good, and that the character of this noble river is such that its bed is practically unchangeable. In this respect it is unlike the alluvial Mississippi, which requires a fleet of ten powerful dredges to maintain the channel.

In pursuit of great economy and money-making capacity, the size of vessels is ever on the increase. Hence the necessity for deeper channels and greater

*An abstract of a paper originally read before the Canadian Society of Civil Engineers.

facilities for handling of cargoes. The condition of the St. Lawrence ship-channel, in 1901, was that the desired 30 ft. stage of water was still some distance off. There remained some 25 millions of cubic yards

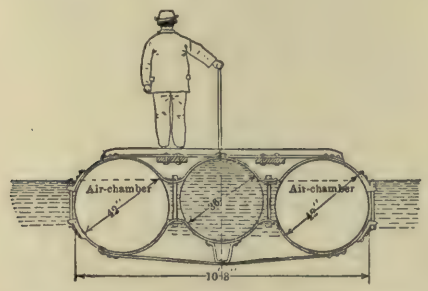


FIG. 2. CROSS SECTION OF FLOATING PIPE-LINE.

to be dredged, and the fleet of six large dredges were removing it at the rate of about 2½ million yards per season. In order to meet the demands of commerce and to complete the 30 ft. stage as early as possible, it was evident that something must be done to hasten the work. A large part of the balance remaining to be done lay in the soft clay of Lake St. Peter.

THE WORK TO BE DONE.

The existing channel through the lake was 300 ft. wide in the straight portion, and 27½ ft. deep (or 26·1 at new datum of extreme low water), and about 18 miles long. The immediate work to be done was deepening to 30 ft. and widening to 450 ft. To allow a little margin the actual cut taken out in the deepening was about 5 ft., and the thickness of cut in the widening was 18 ft. to 20 ft. In the bends the width increases to 700 ft. The total volume to be removed to accomplish the deepening and widening in Lake St. Peter alone was, therefore, in the neighbourhood of 15,000,000 cubic yards. To remove this at a much more rapid rate than was heretofore possible, the then Minister of Public Works, the Hon. J. Israel Tarte, after investigating the subject, resolved on the adoption of the hydraulic type of dredge, and the writer was commissioned to design a dredge that would have a working rate of 2,000 cubic yards per hour.

EXISTING CONDITIONS.

The conditions which presented themselves were as follows :—

A channel 26 ft. deep at low water about 300 ft. wide in the straight part and 600 ft. in the bends, and 18 miles long, with 10 ft. to 12 ft. of water on the banks. The section to be removed was that due to deepening the present cut 5 ft. and widening it 150 ft., and material blue clay of a varying degree of softness with some sand and stones in places.

The dredge, therefore, must fulfil the following conditions :—

1. It must be able to make a cut 700 ft. wide at one time and 5 ft. to 10 ft. thick at one cut.

2. It must leave a clean and level bottom and cut mechanically the entire area, as the material is blue clay and will not run or wash like sand.

3. It must deliver the material sufficiently far to one side of the channel to avoid any risk of washing back again.

4. The floating pipe-line must be so arranged that it will freely permit of the movements of the dredge, and that it will withstand the winds and waves due to the locality, and which are severe at times.

5. The dredge must be so worked that it will not obstruct the channel for passing ships.

6. The anchorage and movements of the dredge must be so arranged that the feed will be continuous and uniform.

7. The capacity to be a working rate of 2,000 cubic yards per hour.

8. The dredge must have ample coal supply and provision for a double crew.

The dredge *J. Israel Tarte* was designed to fulfil the above requirements, and was built by the Polson Iron Works, of Toronto, Ontario.

All drawings and patterns of every detail of the dredge were specially prepared and all materials specially ordered, and the time which elapsed between commencement of the drawings and patterns and the testing of the dredge under steam was eight months.

The fleet of dredges previously existing and engaged on the ship-channel between Montreal and Quebec comprises six elevator dredges, which, taking hard and soft material together, took out 2,479,385 cubic yards in the fiscal year ending June 30, 1901, at a total cost of $128,259·17, or an average of 5.1c. per cubic yard. These dredges have been brought to a high state of efficiency, and are the improved development of the early dredges on the work, the first of which was imported from Scotland in 1832.



FIG. 3. ANOTHER VIEW OF THE DREDGE SHOWING PIPE-LINE.

The state of the art of building large hydraulic dredges at this time showed that it was possible to employ pumps of large power and capacity, and to deliver material through floating pipe-lines to a distance sufficient to meet the conditions of the present case. The great dredges of the Mississippi River (several of which were designed by the writer) contributed much useful data and experience.

POINTS OF NOVELTY.

No examples existed of long-distance pipe-line dredges of large size which made wide cuts. Large dredges in America which discharged through pipe-line either anchored by spuds making a radial cut, or by mooring lines, making a straight forward feed. Sand-pump hopper dredge practice of European designs offered no useful points. Here was, then, the necessity for a new application of the hydraulic principle of dredging, the points of novelty being: first, the lateral feed of 700 ft. width, while discharging to a long distance through a pipe-line adapted to such movement; 2nd, cutting mechanically over every foot of the ground in blue clay, and to do this without clogging; 3rd, the construction of a pipe-line that would be capable of standing some stress of weather and wave-action.

To this extent, therefore, this dredge was experimental, and the present paper will describe the results of the experiments and the methods adopted to improve the detail parts after testing. The writer's observation of the elevator dredges in Lake St. Peter led him to conclude that here was a clay deposit which could be worked successfully by the hydraulic method if the proper apparatus for cutting or digging it were employed. The clay is of a soft, unctuous nature, sometimes partly silicious, bluish in colour and of a character suitable for brickmaking, or pottery. It dumps well from the buckets of a ladder dredge and slides readily down the chute into the barges in chunks, frequently the whole size of the bucket and showing the markings of the rivets. The problem in the new hydraulic dredge, therefore, was to cut this clay regularly and uniformly, and feed it into the mouth of the suction pipe without clogging. Once there, it would slide freely along and be discharged without difficulty, and by making the pipe of large diameter and the pump with passages of large section, the clay could go through in lumps even more readily than sand or finely divided material of like nature, which would tend to precipitate. Thus the hydraulic apparatus is used, not only for dredging, but for purposes of transportation.

CAPACITY.

In considering the question of capacity, the dredge was designed to have a theoretical rate of 3,000 cubic yards per hour, and it was deemed that this would be sufficient to give a working rate of 2,000 yards per hour, including the delays incident to regular work, but not counting delays from exceptional causes, storms or repairs. This rate required a section of cut 5 ft. by 6 ft. by a feed of 45 ft. per minute, equal to 3,000 cubic yards per hour. It was, therefore, necessary to provide a cutter capable of dealing with that section and with plenty of margin to spare, and to provide means for feeding it 450 to 700 ft. across the channel at the required rate. As this involved traversing the entire dredge broadside at that rate, and dragging the semi-submerged pipe-line after it, the power required for this purpose would be quite large, and produce a corresponding necessity of providing strong anchorage to the mooring lines, by which the traversing movement was to be effected.

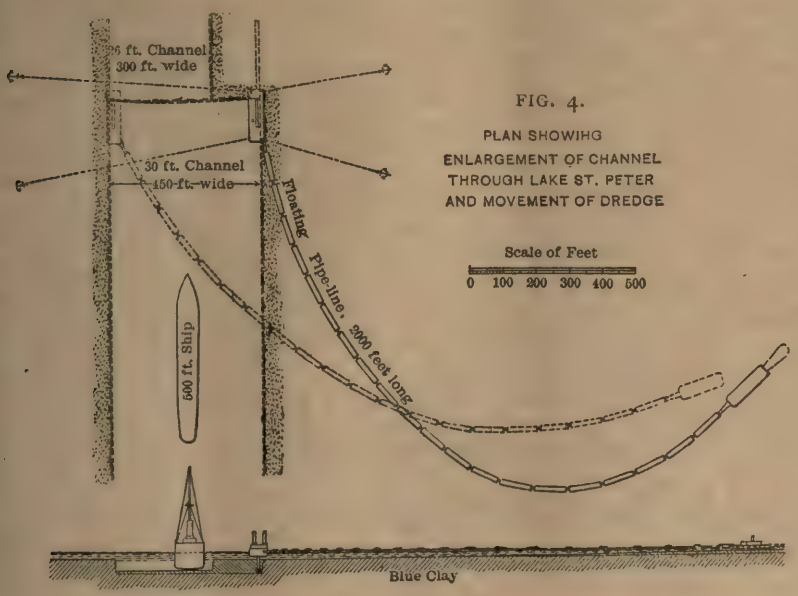


FIG. 4.

PLAN SHOWING ENLARGEMENT OF CHANNEL THROUGH LAKE ST. PETER AND MOVEMENT OF DREDGE

Scale of Feet

0 100 200 300 400 500

THE PIPE-LINE.

In considering the movement of the pipe-line attached to the dredge, advantage was taken of the fact that there is a more or less constant current of $\frac{1}{2}$ to $\frac{3}{4}$ mile per hour in the lake. This is due to the discharge of the river, and is modified by winds and sometimes by tides to a scarcely appreciable extent. The tidal variation at Quebec, 110 miles below, is 9 ft. to 15 ft.; but this gradually becomes less on ascending the river until it becomes lost at the lower end of the lake. The current, therefore, causes the pipe-line to assume a catenary curve of varying tightness according to the travel of the dredge. This is shown by fig. 4, which is a diagram showing the movement of the dredge and the relative position of the pipe-line.

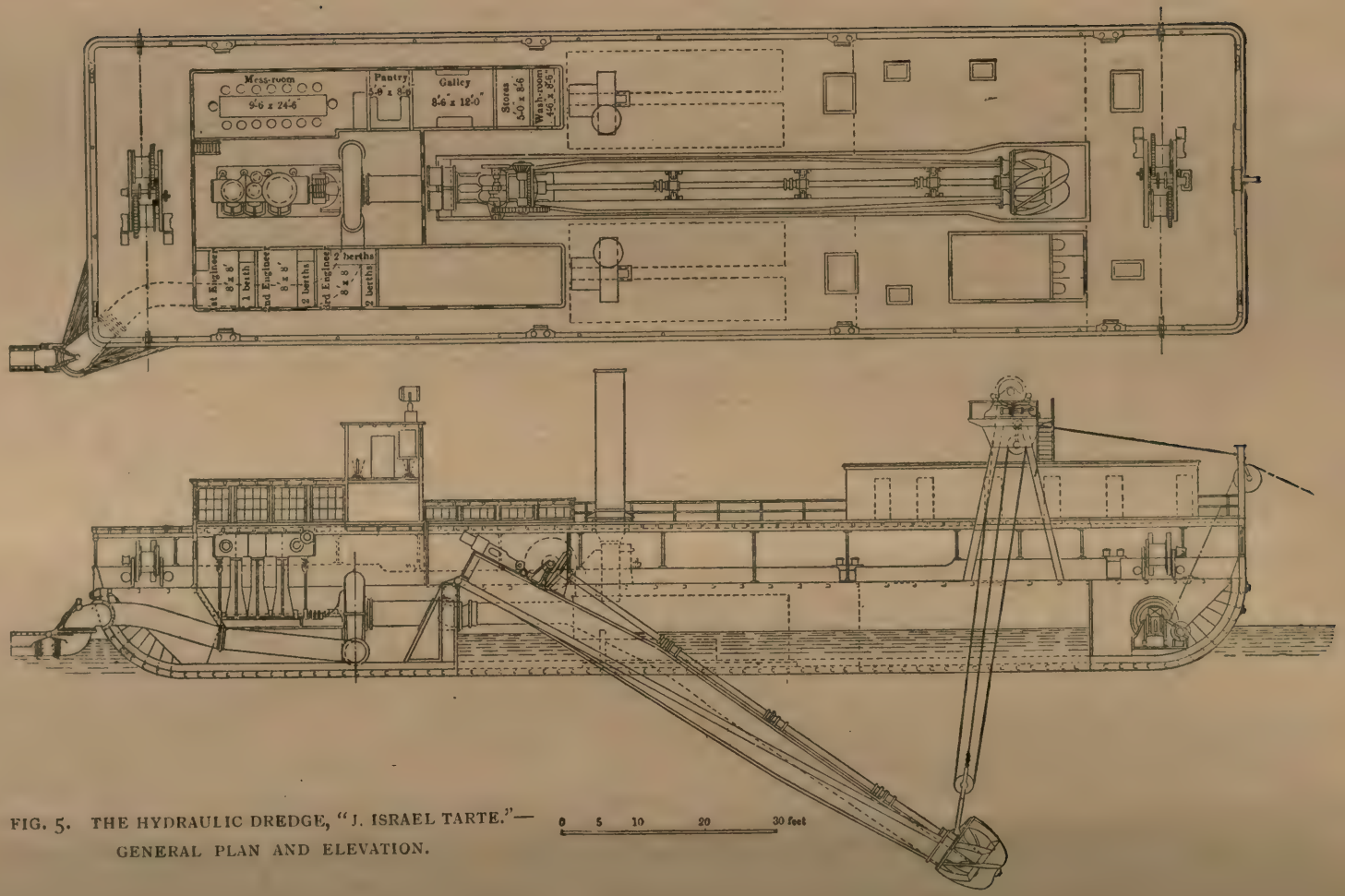


FIG. 5. THE HYDRAULIC DREDGE, "J. ISRAEL TARTE."—GENERAL PLAN AND ELEVATION.

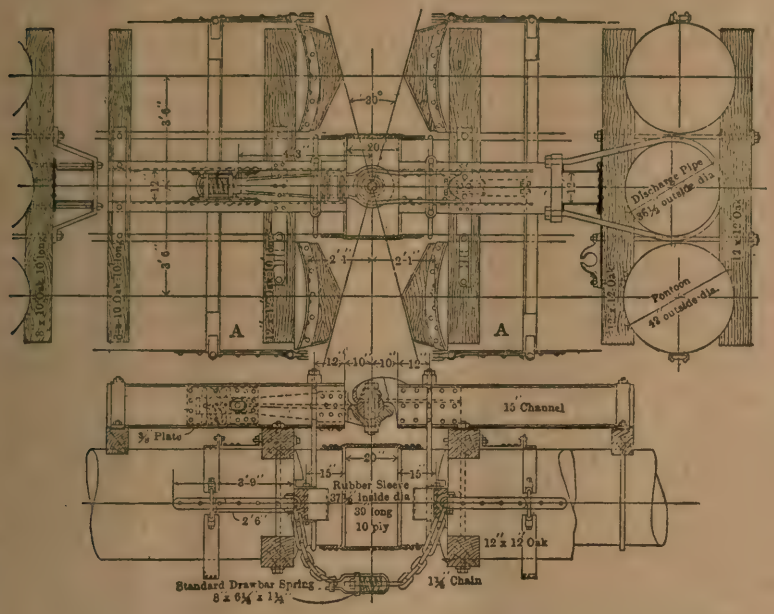


FIG. 6. ILLUSTRATING GENERAL CONSTRUCTION OF PIPE-LINE AND JOINTS.

The current, therefore, was employed to deflect the pipe-line to the form of a loop having slack enough to permit the dredge to traverse 450 ft. In order to utilise the current for this purpose, and at the same time render the pipe-line less exposed to the wind and waves, it was designed to be two-thirds submerged. The weight of a large steel pipe filled with water and mud is very great and would require very large pontoons to carry it in the air, but by partially submerging it, the buoyant power required is much reduced.

The form of pipe-line adopted is that of a central conduit, 36 in. diameter, carried by two cylindrical pontoons or air chambers, 42 in. diameter, the three being bound together by truss-frames clamped upon them as shown in fig. 2. In this way no bolts or rivets are put into the air chambers, and they may be readily taken apart.

The pipes were made up in 100 ft. sections, and four sections of 50 ft. were made with the idea of putting them in that part of the pipe where greater flexibility was required. It was found, however, that these 50 ft. pipes did not stand the sea as well as the 100 ft. sections, and that, moreover, sufficient flexibility could be had without them. They were accordingly joined together and converted into 100 ft. sections.

The joints connecting the 100 ft. sections were at first made by uniting them with a forged steel pin-connection over the rubber sleeve, thus relieving the rubber sleeve of all strain due to tension of the pipe and permitting the required angular movement. These joints were not strong enough and were found to be too rigid in wave action, and caused heavy strains to be set up, which broke some of the joints. They were temporarily repaired for the first season, and during the winter of 1902–3 new joints of special construction were devised by the writer designed on the ball-and-socket plan to permit of universal movement to a moderate degree, and also fitted with draw-bar springs to absorb the variations of length due to surging and pitching. The ball-and-socket principle was embodied, not in the pipe itself, but in a strong steel frame above the pipe, which was connected by rubber sleeves in the usual way. This has proved entirely successful, and the practical result is that the dredge is capable of continuing at work in all but the heaviest weather. The general construction of the pipe-line and joints are illustrated in figs. 2 and 6. The ball end of the joint is solidly riveted to the frames on the pipe, while the socket end is fitted to slide in a casing or frame, and its movement is resisted by springs, as shown. These springs are two in number and are heavy car springs. They are $6\frac{1}{4}$ in. diameter and 8 in. long, and made of round steel, $1\frac{1}{4}$ in. diameter. The springs are carried between spring-plates, resting against stops in such a way that the springs are compressed for either thrust or pull of the draw-bar, and the whole arrangement is built in the very strongest manner of steel, and each joint is strong enough vertically to carry half the entire weight of a pontoon upon it. In other words, should the entire buoyancy be removed from one pontoon for 50 ft. of its length by the trough of a wave, its weight could be rested upon the adjoining pontoon with safety.

This pipe-line has now been tested during the working season of 1903, and no breakage or failure of these joint connections has occurred; neither does the ball-and-socket arrangement show appreciable wear.

DETAILS OF THE DREDGE.

Turning now to the dredge itself, the general form and arrangement will be seen by referring to fig. 5. The hull is of steel and is 160 ft. long, 42 ft. beam, 12 ft. 6 in. deep. The plating is generally $\frac{1}{2}$ in. thick on the bottom and $\frac{3}{8}$ in. on the sides with $\frac{5}{16}$ in. deck. The hull is rounded at the bilges but is rectangular in plan with rounded ends in side view. There is a central opening, or well, through which the suction-pipe works. This well is 8 ft. wide, except at the forward end, where it is 10 ft. wide to admit the cutter, and it is of sufficient length to receive the pipe. The suction-pipe is formed of a rectangular steel box girder of great strength, and having its lower horizontal web

extended in width so as to fit between the sides of the well. The flanges of this horizontal girder are formed of two angle irons, 5 in. by 5 in. by ½ in. covered with a plate 12 in. by ¾ in., which bears against the sides of the well. This is for the purpose of withstanding the great lateral strain due to feeding the dredge sideways and with the cutter in contact with the bottom. The dredge being designed to work at a depth of 50 ft., the suction-pipe forms a lever within the hull, and both the hull and the attachments of the pipe thereto are of great strength, to withstand the stresses due to contact with the bottom in a seaway and due to the lateral feeding. The suction-pipe is hinged to the hull at the deck by means of massive steel hinge castings, and a steel bulkhead extends the entire width of the hull at this point. The sides of the hull are extended above the deck to form a solid steel bulwark entirely around the dredge, the hand rail being formed of an 8-in. bulb angle, finished on the outside with 2½ in. half round. These bulwarks form a protection against the seas which sometimes break over the dredge.

The suction-pipe is suspended from a double steel A-frame over the forward end of the well, and the lifting winch for raising and lowering the suction pipe is carried on top of this frame. The suspension tackle is formed of two sets of heavy wire rope tackle, the diameter of the ropes being 1⅛ in. The sheaves are of cast steel with turned grooves and brass bushings. The hauling parts of this tackle in this way pass direct to the drum of the winch without the intervention of any idler sheaves as would be the case if the winch were located below the deck. This arrangement has the further advantage of getting this winch out of the hull where it would occupy valuable space.

The main engines are of the triple expansion marine type, having cylinders 20 in., 31 in. and 50 in. diameter, by 25 in. stroke. They are adapted to run at 150 revolutions per minute, with 150 lb. of steam. The engine room is provided with a complete outfit of all the usual accessories, including air pump, feed pump, surface condenser, heater, bilge pumps, etc.

The material is excavated by an improved rotary cutter, 9 ft. 6 in. diameter, by 9 ft. long, the weight of which is 10 tons. It is formed of steel blades with specially-designed clearance spaces between them, so as to avoid clogging with the material and the suction-pipe and passages through the pump are made very large for the same reason. The cutter is driven by a pair of engines placed on top of the suction-pipe at the upper end. These engines are of the double tandem type of 300 i.h.p. They are of the most substantial description, with all bearing surfaces extra large for continuous heavy duty. The gearing and power transmission for these engines is of exceptional strength and capable at all times of encountering immovable resistances with full head of steam on the engines without risk of breakage. The main gearing driving the cutter is of cast steel, 5 in. pitch and 15 in. face. It is worthy of note that during the whole two seasons that this dredge has been in service no breakage, or failure of any kind, has occurred to any part of the suction-pipe, cutter, or cutter-driving apparatus. This is due to the exceedingly substantial character of the design and construction, and the direct manner in which the strains are met; also to the fact that the engines are the weakest part and can be stalled at any time with safety.

Steam is furnished by four boilers, having collectively 8,500 square feet of heating surface, and adapted for working pressure of 160 lb. There is coal bunker capacity of 200 tons.

The main pump is of the centrifugal type, having cast-steel runner of enclosed type and heavy cast-iron shell.

The whole of the operations of the dredge are controlled from the pilot-house on the upper deck. Here are located the levers for both the bow and stern anchorage winches and the lifting winch for the suction-pipe; also a system of bells and signals to the engine room. The pilot house is so placed that the operator has an unobstructed view up and down the river; also of the entire discharge-pipe. It is necessary for the dredge to get out of the channel to enable vessels to pass. For this purpose the operator causes the dredge to remain on that side of the channel on which the discharge-pipe is situated and slackens out the breasting lines on the opposite side so that they rest upon the bottom. The dredge is fitted with complete quarters for a double crew of 36 men, or 18 men on each shift.

RESULTS ATTAINED.

Turning now to the results accomplished, the output month by month steadily increased until in September, 1902, the quantity was 580,000 cubic yards; in October, 600,000 cubic yards—this notwithstanding the defects to which reference has already been made, and which were remedied during the following winter. The length of channel deepened in September was 7,800 lineal ft., 325 ft. wide by 5 ft. average thickness cut, and in October, 8,000 lineal ft. The dredge thus demonstrated her ability to deepen the channel to 30 ft. at the rate of a mile and a half per month.

Owing to lateness in starting in the spring and to early stoppage in the fall on account of accident to the boilers, the season of 1903 was very short, being 126 working days. During this time the work accomplished was 2,671,750 cubic yards, scow measurement, equal to an average of 21,200 cubic yards per day for the season. This includes all delays from whatever source. The best month was September, 1903, when the output reached the phenomenal figure of 757,100 cubic yards. This was accomplished in 25 days of 552 working hours, giving an average rate of 1,646 cubic yards per hour, or 30,280 cubic yards per day for the month. Of this time 460 hours was actual dredging, being 83¼ per cent. of the possible time.

A BITUMINOUS COAL-BREAKER.

BY

LEWES STOCKETT.

The successful operation of the coal-breaker here described will make available large fields of coal in Montana, which, on account of the impurities present, have been hitherto regarded as unworkable. It was originally described before the American Institute of Mining Engineers.—ED.

DURING the year 1903 a building and machinery corresponding to an anthracite coal-breaker was erected at the town of Stockett, Cascade County, Mont., for the purpose of breaking-up and cleaning bituminous coal.

The coal is mined from a vein of the Kootenai group of the Lower Cretaceous measures having the following section :—

	Feet.	Inches.	Feet.	Inches.
Sandstone ledge				
Top coal	1	2		
Slate			0	5
Top bench	1	6		
Bone			0	7
Gray coal	1	3		
Blacksmith coal	2	5		
Bone			0	6
Coking coal	1	5		
Metamorphosed fire clay				
Total... Coal	7	9		
Total... Refuse			1	6
			9	3

The vein is nearly horizontal in position, and each bench differs in quality as shown in Table I.-

TABLE I.—*Analysis and Specific Gravity of Stockett Coals.*

	Moisture.	Volatiles.	Fixed Carbon.	Ash.	Sulphur.	Specific Gravity.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	
Top coal	4.35	30.90	54.90	9.85	2.56	1.29
Top bench	2.85	28.95	53.45	14.75	1.64	1.29
Gray coal	3.05	25.16	51.55	20.30	1.33	1.75
Blacksmith coal	2.65	35.85	51.35	10.15	1.45	1.29
Coking coal	3.01	29.55	52.09	15.35	1.92	1.44

There are no partings whatever between the different benches of coal, slate and bone, the vein being very hard and a solid mass from top to bottom, which, with a liberal number of pyrite nodules, called sulphur-balls, scattered promiscuously throughout the vein, make the coal a difficult one to clean. Previous to the building of the breaker, the cleaning was done with indifferent results by the miner at the face, and the nut-coal was washed in a jig. Scarcity of water, however, prevented the erection of a plant to wash the whole product, and at times necessitated the shutting down of the nut-coal washer.

The difficulties to be overcome in separating the different material of the vein will be appreciated by a study of their specific gravities, shown in Table II.

TABLE II.—*Specific Gravity of Material Mined at Stockett.*

Sulphur balls	4·140
Slate	2·402
Bone	1·963
Gray coal	1·5 to 1·751
Coking coal	1·440
Other coal	1·290

After a series of experiments, a scheme of treatment supplementary to the cleaning by the miner was determined upon and carried out, one of the requirements being so to connect the new work to the old tipple that the change could be made from one to the other without delay in the shipment of coal. This arrangement was successfully accomplished, and accounts for some things about the building that may be open to criticism—things which would be arranged differently in an entirely new plant. Ground was broken for the foundations of the building, March 26th, 1903, the timber-work was commenced April 16th, the machinery started August 10th, and has since been in continuous operation every week-day with gratifying results.

The following illustrations have been prepared from the working-drawings to show the general arrangement of the plant and the manner in which the machinery has been installed :—Fig. 1. Ground plan; Fig. 2. Longitudinal section showing especially the machinery; Fig. 3. Transverse section showing the machinery; Fig. 4. Transverse section showing the bins; Fig. 5. Plan at the screens; and Fig. 6. Section of the tipple. The letters in the text of this article, referring to the legends, are common to all of the illustrations.

The coal, carried from the mine in pit-cars of a capacity averaging about 1·5 tons to the car, is weighed on an automatic scale and thence dumped by the cross-over tipple *A*, over the bar-screen *B*, 12 ft. long, 6 ft. wide and having a pitch of 6 in. to the foot with spaces between the bars 2 in. wide, which screens out that portion already small enough (about 30 per cent. of the total), and, falling on the shaking screen *C*, having 1-in. round perforations, 6-in. throw and 100 strokes per minute, removes the slack from the coal. The slack is loaded directly in the railroad car or taken to the boiler-room by means of a wire-rope conveyor. The portion of the coal that goes over the shaking-screen *C* slides into a hopper *D*, from which it feeds into an elevator *E*, consisting of a rubber belt 16 in. wide, having 8-in. by 14-in. buckets placed every 16 in. and operated with a speed of 225 buckets per minute, which elevates the material to the top of the building.

The coal that passes over the screen *B* falls upon a travelling belt *F*, 4 ft. 6 in. wide and 26 ft. long, having a speed of 33 ft. per minute; and from this belt any large pieces of slate, or other impurities, machine-picks, car-couplings, sprags, etc., are removed by men stationed on either side and thrown into a rock-elevator *G*. This travelling band is operated by a clutch gear *H*, which in case of a very large quantity of impurities appearing is thrown out, the belt stopped, and all of the impurities removed before the coal drops into the rollers *I*, which reduce the coal to a size not exceeding a 4-in. cube. It was found necessary to reduce to a 4-in. size in order to prevent the concealment

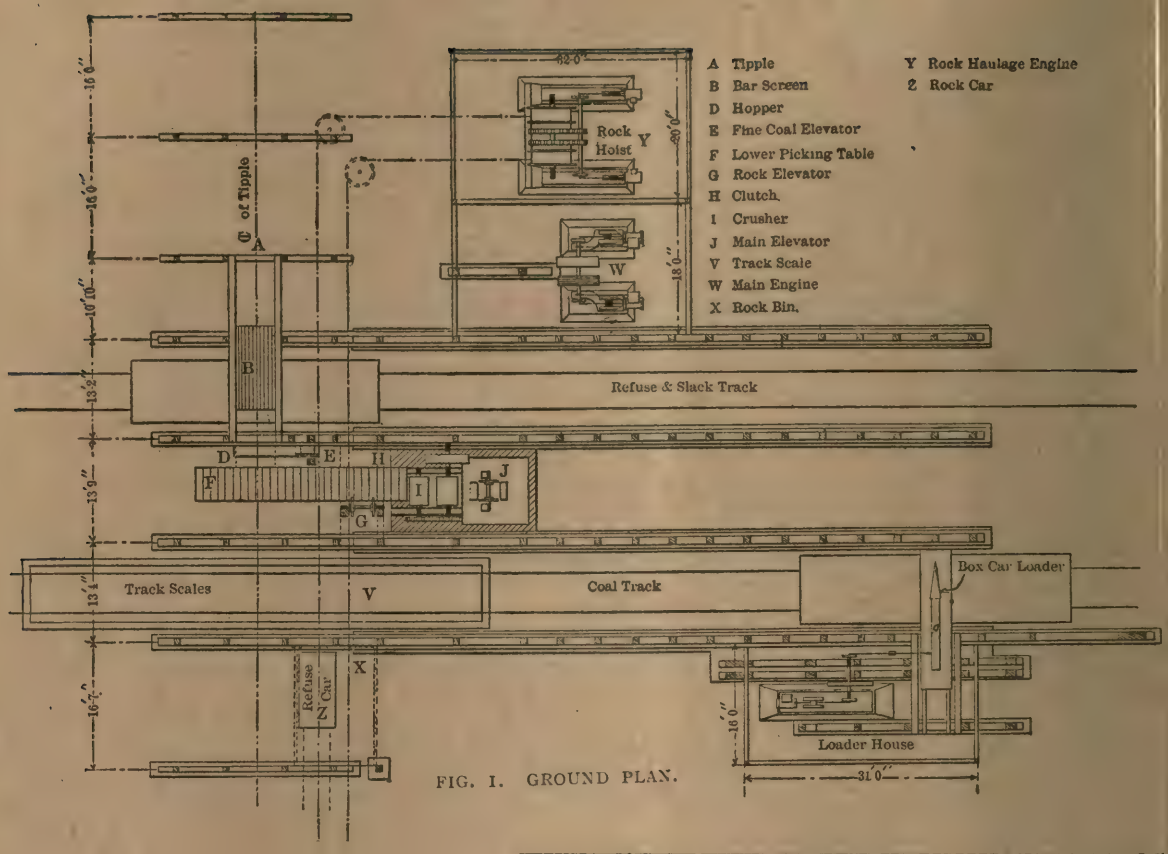


FIG. 1. GROUND PLAN.

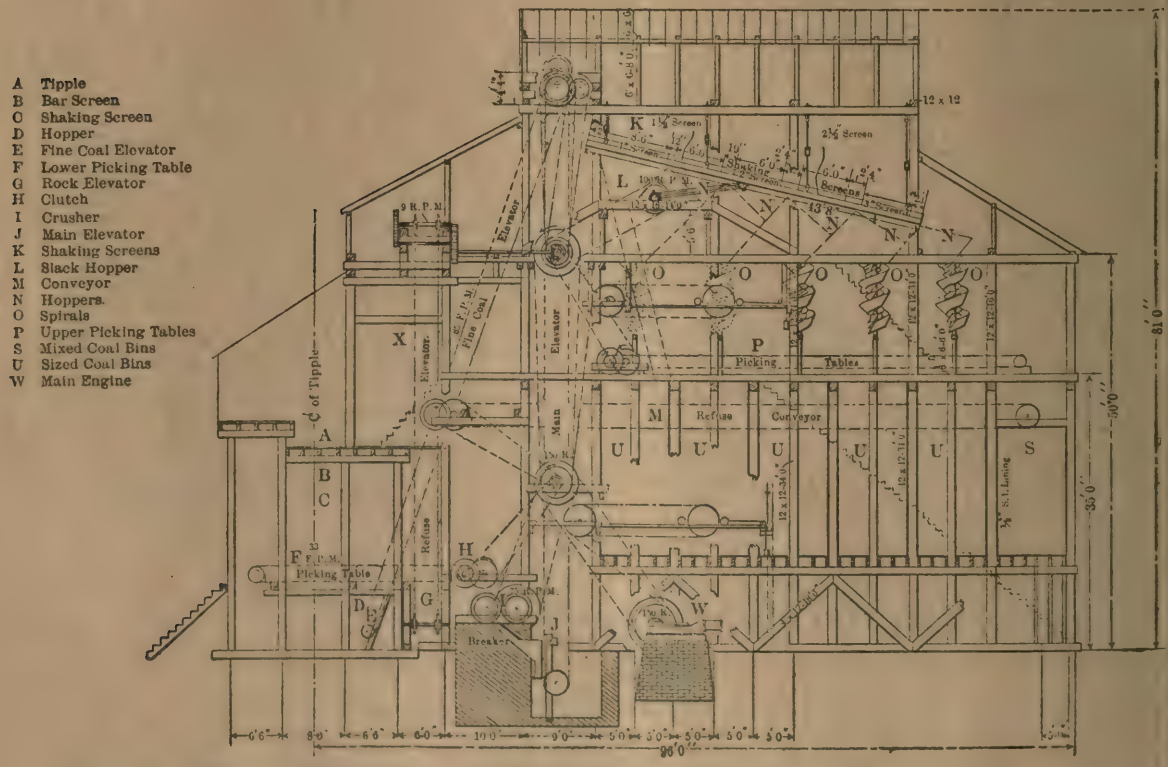


FIG. 2. LONGITUDINAL SECTION SHOWING ESPECIALLY THE MACHINERY.

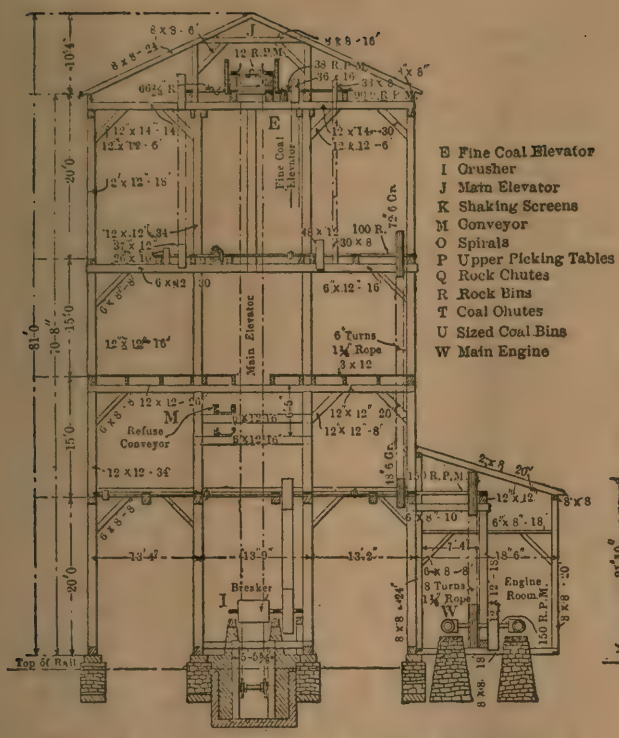


FIG. 3. TRANSVERSE SECTION SHOWING THE MACHINERY.

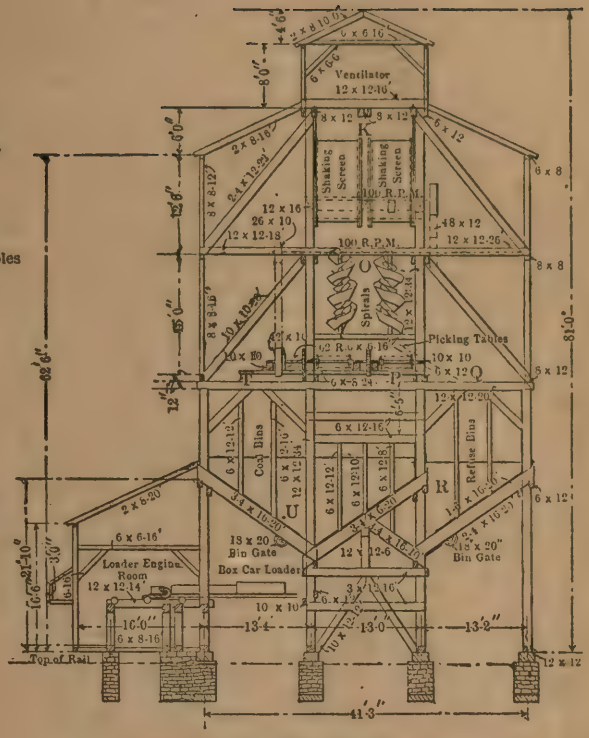


FIG. 4. TRANSVERSE SECTION SHOWING THE BINS.

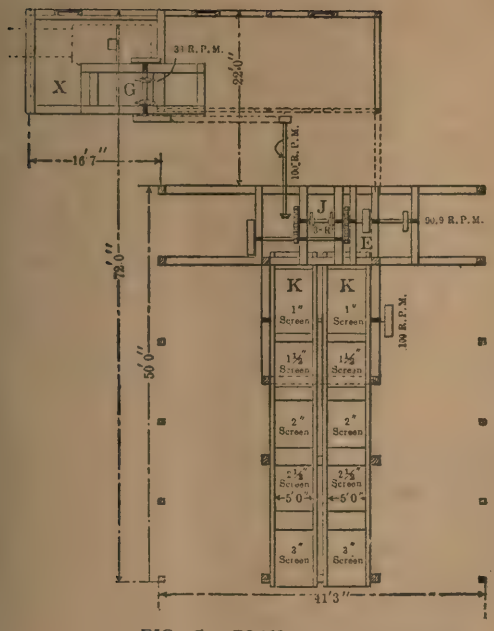


FIG. 5. PLAN AT THE SCREENS.

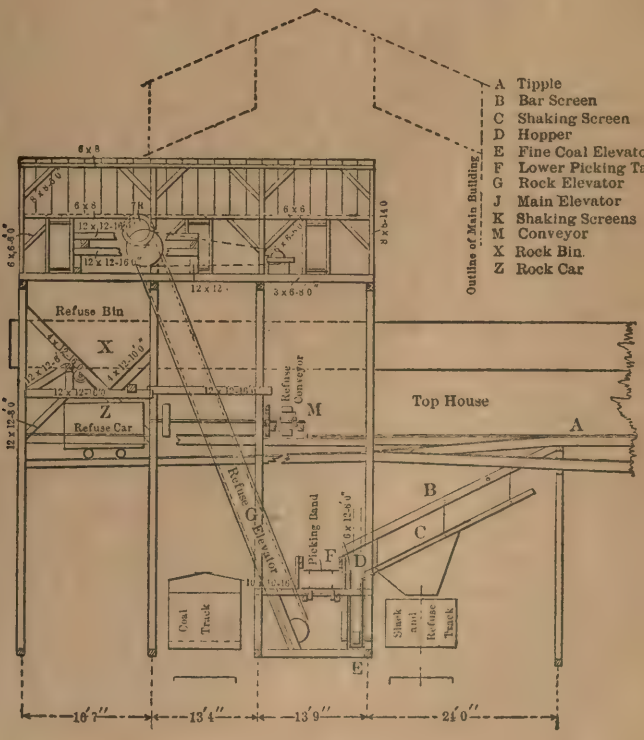


FIG. 6. SECTION OF THE TIPPLE.

of a sulphur-ball in a lump of coal. The rollers are of the removable-tooth style, 36 in. in diameter, 48 in. wide, and revolve at 75 revolutions per minute.

From the rollers the coal is elevated by a continuous elevator *J*, having buckets 12 in. by 30 in., and operated at a speed of 65 buckets per minute. Each bucket has a capacity of 110 lb. of coal when level-full, which is equivalent to 200 tons per hour; the capacity of the fine-coal elevator *E* is 90 tons per hour, giving a combined elevating capacity of 290 tons per hour, or 2,900 tons per day of ten hours, an amount which, added to the slack screened out at *C*, gives a total capacity of 3,200 tons per day.

The coal elevated by the elevators, *E* and *J*, is evenly divided over the shaking-screens *K*, 5 ft. wide and 46 ft. long, having a 3-in. pitch to the foot, a 6-in. throw and 100 strokes per minute. The plates of the screens have respectively 1-in., 1·5-in., 2-in., 2·5-in., and 3-in. round perforations, and separate the coal into slack, pea, nut, stove, egg, and broken sizes.

The slack resulting from the breakage of the coal is found to be clean, and, not needing any further preparation, it descends through the hopper *L* to the top strand of the conveyor *M* (having 10-in. by 20-in. flights spaced every 3 ft.), and is taken directly to the mixed coal-bin *S*. The other sizes are fed by means of the hoppers *N* into spiral separators *O*, which separate the greater part of the impurities from the coal. These impurities pass either to the lower strand of the conveyor *M* and are conveyed to the rock elevator *G*, or from one set of spirals to the bins *R*, by means of chutes *Q*, which give an opportunity to re-pick the refuse by hand and save any coal that may be in it. The refuse is finally loaded into railroad-cars and used by the railroad for widening banks, etc.

From the spirals *O* the coal drops on to two picking bands *P*, 4 ft. wide, 50 ft. long and having a speed of 40 ft. per minute, which convey it to the mixed coal bin *S* and gives an opportunity to pick out by hand any impurities not removed in the spirals; from one set of spirals, inclined chutes *T* pass the coal into bins *U* for loading straight sizes, any remaining impurities being removed by hand while the material is on these chutes.

The rock elevator *G*, having continuous buckets 12 in. by 30 in., and speed 50 buckets per minute, elevates the impurities into a bin *X*, from which it is loaded into a 6-ton car and hoisted by a pair of geared tail-rope engines, with 10-in. by 18-in. cylinders, to the top of the adjoining hill and automatically dumped.

The machinery of the entire plant is driven by a double engine *W*, with cylinders 13-in. by 18 in., running 150 revolutions per minute; the connection to the first and second line-shafts being made by rope drives, and all other connections, of rubber belts.

From the bins *S* and *U* the coal is loaded into railroad-cars, a box-car loader being placed opposite the chute *S* to load box-cars. The cars are weighed on the scale *V*, and it may be of interest to know that, when loading the mixed-coal into box-cars, the entire product of the breaker passes through an opening 12 in. by 14 in. in area.

The building is heated by steam-coils supplied with live steam, and is lit by incandescent electric lights. It has two stand-pipes with hose-connections and hose for fire-protection.

On account of the slight difference in the specific gravity of the gray coal and the bone, the spirals are adjusted so as to retain only the slate and flat sulphur balls, leaving the bone to be removed by hand. The round sulphur balls, which on account of their shape are the first to leave the spirals and go with the coal also have to be removed by hand.

The results obtained are given below, showing the percentages of refuse in the various sizes:—In pea coal, 4; in nut coal, 3; in stove coal, 3; in egg coal, 2; in broken coal, 1; and in mixed coal, 2·5 per cent. Of 2,000 tons of the mine-product, which is daily dumped into the breaker, 200 tons of the various impurities are removed, and these impurities do not contain on an average over 1 per cent. of coal.

The mixed coal is used by the railroads as a locomotive fuel, and proves an excellent article; the various sizes are used in the commercial trade, the slack and pea sizes making the very best of boiler fuel.

The cost of the breaker in the section where the highest wages are paid in the United States and where freight is a very large item, was £8,857 17s. 8d. divided as follows:—

	£ s. d.
General expense	98 8 6
Foundations	509 9 5
Lumber	751 10 5
Machinery	2,659 7 0
Separators	573 11 7
Scale	25 15 7
Hardware	167 17 11
Labor	2,229 6 9
Freight	1,842 10 6
Total	£8,857 17 8

The above figures include 300,000 ft. of lumber and 400 yards of masonry, as well as duplicate pieces for all of the parts of the machinery that are liable to break or wear out.

The cost of operation of the plant over and above the force previously used on the old tipple is as follows:—

	£ s. d.
Coal inspector on lower picking band	0 12 6
3 men on lower picking band	1 11 3
1 man looking after screens	0 10 5
1 man looking after spirals	0 12 6
15 boys picking slate, etc.	3 2 6
1 breaker boss	0 12 6
1 engineer, also hoists the rock ..	0 16 8
1 machinist, oils and keeps machinery in order	0 14 7
1 man loading rock	0 10 5
	£9 3 4
1,500 tons (1,800 less 300 slack) per ton ..	0.03
To which add interest on investment, taxes, insurance, wear and tear, supplies used and repairs, which as near as can be estimated is	0.03
Total additional cost per ton	0.06

The largest item of cost, however, comes from the decreased production from what was formerly shipped by reason of the removal of the impurities; the total cost being now divided by 1,500 tons of lump-coal as compared with 1,700 tons formerly; this is met by the increased price received for the coal, and which at the increased price is a cheaper fuel to the consumer than the former product at the lower figure.

The success of this plant will make available large fields of coal in Montana, which on account of the impurities present were hitherto regarded as unworkable. However, it is only with coals hard enough to keep their shape, and where a marked difference exists both in the specific gravity and the shape of the coal and the impurities, that the spirals will work successfully.

A NEW AUTOMATIC WEIR CREST.

BY

E. O. MAWSON, *Executive Engineer, Public Works Department, Bombay.*

The writer gives a concise account of a New Automatic Weir Crest which effects the storage of water, while at the same time avoiding the risk of inundation after heavy rains.—ED.

FLASH-BOARDS and temporary crests, placed on the top of permanent masonry weirs, which can be removed during heavy rains and replaced on the subsidence of the flood, have for long been used in tropical countries to collect and store the normal flow above the permanent top of the weirs.

Owing to the increasing spread of the contours, a temporary obstruction on the top of a weir of only a few feet in height will often double the capacity of a reservoir. The great objection to their use is the difficulty encountered in promptly removing them on the approach of floods, and their replacement when the flow begins to diminish with sufficient speed to prevent loss of water.

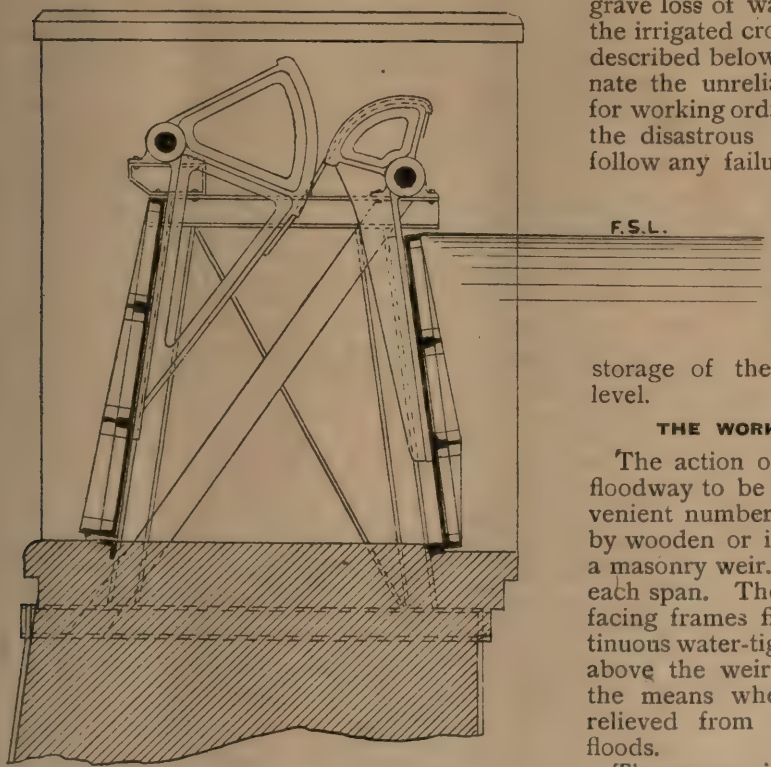


FIG. I—DESIGN FOR IRON GATES ON WEIR CREST.

NEED FOR AN AUTOMATIC DEVICE.

In tropical rivers the floods are very heavy, and the volume of water during storms increases with extraordinary rapidity. A small stream will in a few hours become a raging torrent. The subsidence of the discharge to normal limits is equally rapid, and it is a matter of the greatest difficulty to remove the temporary crest in time to allow the flood free passage, and to replace the crest on the diminution of the discharge quickly enough to prevent a large quantity of the water going to waste. Failure to promptly remove the crest results in the inundation of the property above the weir, and possibly in the destruction of the dam itself; while any hitch in replacing the crest may mean grave loss of water, entailing the drying up of the irrigated crops. The automatic sluice gates described below have been designed to eliminate the unreliable human element necessary for working ordinary crests and sluice gates, and the disastrous consequences which invariably follow any failure to remove the crest on the approach of sudden floods.

It is hardly necessary to point out the great importance of giving adequate relief and providing a free passage for floods and at the same time insuring the certainty of the storage of the diminishing flow to a fixed level.

THE WORKING OF THE NEW GATES.

The action of the gates is as follows: The floodway to be raised is divided into any convenient number of spans by masonry piers, or by wooden or iron frames placed on the top of a masonry weir. The sluice gates are fitted in each span. The up-stream gates resting against facing frames fixed to the piers, form a continuous water-tight barrage holding up the water above the weir; the down-stream gates form the means whereby the up-stream gates are relieved from pressure and opened during floods.

The manner in which the gates act is shown in the accompanying figures. The two sluice

gates are connected by chains or wire ropes acting on segmental levers; when the water overflows into the space between the two gates it gradually counterbalances the pressure on the up-stream and accumulates pressure on the down-stream gate, causing the gates to open and providing a passage beneath them for the flood-water, which would otherwise all pass over their tops. As the volume of the flood rises or falls the sluice gates adjust themselves automatically to the flow, opening and closing in proportion as the volume of flood-water increases or decreases.

When the gates are fully opened the up-stream gate is horizontal, thus offering the least possible obstruction to the flood, while the down-stream gate lies at a slope, parallel with the direction of the stream filaments. The gates are constructed of metal or wood. For heads over seven or eight feet, and where large volumes of water pass over the gates, it is advisable that they be made of metal; but in very many instances wooden shutters, braced and strengthened by iron, will be all that is necessary.

In exceptionally high floods the water passes clear over the gates without submitting them to any strain, the sluice gates when fully open lying parallel to the direction of the filaments of the stream. The gates may rest against facing frames built into the piers, or the water-tight joints between the sluice and the masonry may be formed by rods attached to the gate, which are pressed into the V-shaped spaces between the sluices and the side walls and sill of the framework when the gates close.

They are essentially simple in detail and construction, and possess only the simplest mechanism. Each set of gates in a series acts independently of the others, and they can be erected for any spans—as, for instance, between the piers of existing bridges. The main use of the gates is for raising the level of tanks and weirs, while leaving a free passage of flood-water. Placed in the spill way of a tank, they greatly increase the storage capacity of the reservoir; while, erected on the top of a river weir, they raise the level of flow, allowing it to be taken off at a higher point than would otherwise be possible, reducing the cost of the canal cutting and bringing extra land under control for irrigation. When the streams are heavily silt-laden, the effect of the automatic weir is: First, to deposit heavier particles in the pool above the weir, which are subsequently scoured out by heavy floods; and secondly, to distribute the fine fertilising silt over the irrigated land, instead of carrying it in suspension to waste. The extra head obtained is of great importance on weirs, forming the source of power for hydraulic machinery such as turbines, etc.

PASSING OFF FLOOD-WATER.

Automatic sluice gates placed at intervals in the banks of a canal or inundation river, parallel to the stream, maintain the water at a constant level and automatically discharge all excess flow, thus preventing the disastrous breaches in the embankments due to sudden floods which result, not only in the submersion of large tracts of land, but also in loss of crops due to want of water while the damaged embankments are being repaired. Such gates as those described above can be used to pass canals over depressions and small streams when the cross drainage is intermittent and of small volume, thus saving expensive aqueducts or super-passages, the flood-water escaping through the gates.

By carrying the canal water across the river by an automatic weir, instead of by an aqueduct or super-passage, the canal can be run on the most economical alignment, and any flow in the river is picked up and forms an addition to the canal supply.

In crossing depressions in steep sidelong ground, an opening may be left in the upper bank of the canal to allow the passage of flood-water, an automatic weir being placed opposite to this opening in the down-stream bank. The area covered by the back water will gradually silt up, forming valuable land at or about the level of the canal which will be easily irrigable.

On the crest of the spill-way of tanks these gates increase the storage of the reservoir. On the crest of the river weirs they raise water from the trough and make it available for irrigation or water power at a higher level. By a series of such barrages a river can be converted into a consecutive chain of storage tanks. For canal escapes and on inundation rivers they serve to maintain a fixed level and pass off flood water, and they can be used on weirs across streams for canal crossings.

In addition, they are also useful for regulators in drainage channels, for heading up water at intervals in a canal, to facilitate the discharge through distributaries.

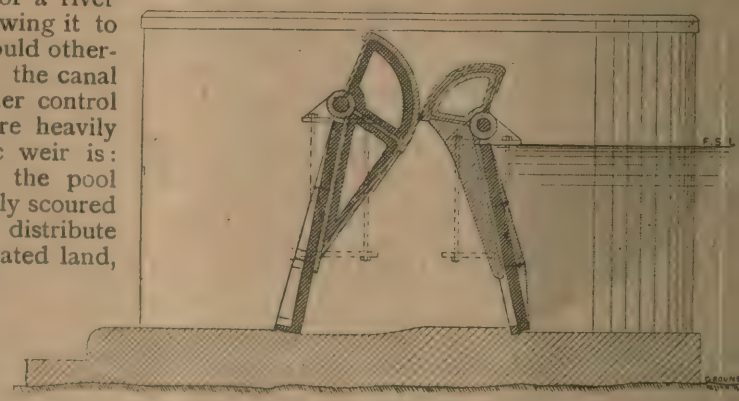


FIG. 2.—NEW AUTOMATIC WEIR CREST.

THE COALING OF SHIPS OF WAR.

BY

GEORGE C. MACKROW, M.I.N.A.

Mr. Mackrow presents details of a proposal for coaling ships at sea, as recently placed before the Royal United Service Institution. The arrangement has been designed by the author, in conjunction with Mr. Herbert Cameron.—ED.

THE coaling of war vessels at sea is now receiving serious attention both by the British Admiralty and most foreign navies. The importance of the subject cannot be over-estimated, as the object lessons received in the late Cuban War have impressed themselves on the minds of all Naval Powers, and from that time to the present various methods have been proposed, but only one has yet been practically tested at sea. This was the Miller Conveyor, which has been somewhat improved upon and tried by the British Admiralty with some success, but it leaves much to be desired yet. The writer believes that only by means of a suspended weight can a constant tension be maintained on the line, and on this principle has been produced a thoroughly practical arrangement which has been tested, both by models and full-sized gear, as far as it is possible on land. The Thames Ironworks, Shipbuilding and Engineering Company, Ltd., await an opportunity of testing it at sea.

The arrangement proposed for transporting coal or other stores from the collier or transport to the battleship or cruiser is as follows: At the fore part of the collier or transport is placed a cylindrical tube built of steel plates and angles and about 5 ft. or 6 ft. diameter, stepping upon the floors of the vessel and sufficiently high above the deck of the collier to keep the bags of coal well clear of the water, say 40 ft. to 50 ft. at the collier and some 30 ft. to 35 ft. at the battleship. This will keep the bottom of the bags about 12 ft. clear of the water. Within the above-mentioned tube or slewing jib we suspend a weight supported from the crown of the tube, having a double set of pulley wheels placed side by side, the two standing parts being joined, and thus forming a bight in the tube, and the two hauling parts carried out some 300 ft. to 400 ft., and being joined also at the battleship, forming a bight there, we have a complete endless line, one half of which, passing over one set of pulley wheels, forms the incoming line, the whole line being endless. This line is kept in motion by the driving wheel round which the bight is carried in the tube in the collier, which is driven by a small steam engine or electric motor placed at the head of the tube. To place the bags of coal on the outgoing line while the latter was in constant motion, became a matter of no small moment, but which has been very successfully dealt with by the following gear: On the fore side of the vertical tube, or slewing jib, we attach two vertical tubes about 3 in. diameter with a spiral slot cut throughout the whole of each length, having a free wheel at the lower end, and a special form of sprocket wheel at the upper end, which is also kept in motion by the above-mentioned engine or motor at the head of the slewing jib. Within these small tubes a series of trolleys are carried connected by short lengths of chain with tightening screws here and there forming an endless train of trolleys, and to each trolley there is fixed a large hook which projects through the slot in the tubes. This slot is so cut as to bring the hooks into position at the bottom of the hoist so as to lay hold of a double hook attached to each coal bag. The trolleys each in turn lift a bag of coal of, say, 200 lb. to the head of the slotted tube where the slot, being cut slightly spiral, so guides the hook as to turn it downwards, and thus throw the bags off the hook on to what we call a "shunt bar," one end of which is carried by the vertical tube, the other end being supported by the endless line. When the one hook on the bag has been thrown off, the other hook, which has a small roller in its throat, carries the bags down the shunt bar, which, being placed a foot or so above the endless running line and resting at the lower part on the running line, gives an impetus to the bags travelling down the shunt bar by which they attain the same speed as the running line by the time they reach it, and thus avoid all shock. The bags of coal by this means are placed on the line at an equal distance apart and in number according to the distance the collier and battleship are arranged to work apart, say some 300 ft. The bags of coal as they reach the free wheel on the battleship are again automatically transferred from the running line on to another shunt bar, and are thus landed at any desired part of the deck of the battleship or cruiser. The empty bags being returned by means of the incoming

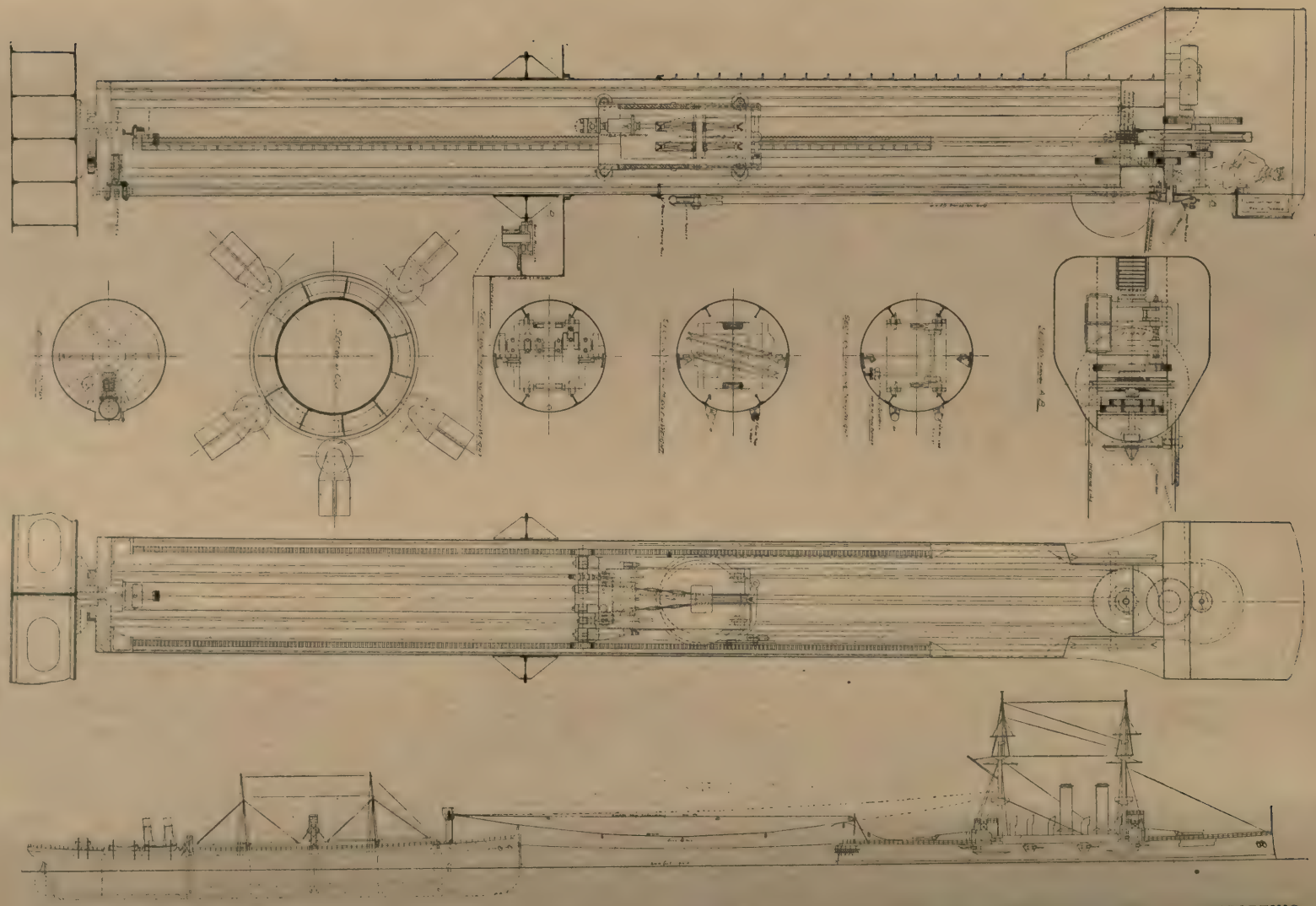


FIG. 1. VERTICAL AND CROSS SECTIONS OF MESSRS. MACKROW AND CAMERON'S "EXPRESS" PATENT ARRANGEMENT FOR RAPIDLY TRANSPORTING COAL OR OTHER STORES FROM COLLIER OR TRANSPORT TO WAR-SHIPS AT SEA OR AT ANCHOR. FIG. 2. BATTLESHIP COALING AT SEA.

line to the collier, some half-dozen bags can be put together and carried by one hook or sent separately as desired, and when they have reached the slewing jib in the collier they are also automatically transferred from the running line by means of a shunt bar and sent down to the deck of the collier to be refilled and the same operation repeated.

The above is an explanation of the method of transporting automatically the coal or any stores in bags from the collier to the battleship or cruiser, and can be fitted in the forepart of any vessel, preferably in the foremost hatchway, where, by securing a steel plate and angles to the coamings, or decking over the fore part of the hatch and cutting a circular hole in this deck to allow the tube or slewing jib to pass through, it will give the required lateral support; the heel of the tube, being supported on a pivot on the floor of the vessel, will carry the entire weight of the tube, tension weight, endless line, etc. This tube or slewing jib is made to *slew* in order that the collier may be able to tow direct astern or on the quarters of the battleship, and so the endless line be kept with a direct lead from the sheaves in the head of the jib to the sheaves on the shear legs or gantry in the battleship. The slewing of the jib is under the control of the man in charge at the head of the jib or tube, who from that point can control also the hoisting of the coal and the transporting to the battleship, and stop or start in an instant any one of the operations. To bring the coal in bags to the heel of the hoist above described, special arrangements would have to be made if the operation is to be done quickly. If an ordinary collier or cargo vessel is employed it will be necessary to have derricks over each hold, the men in the hatchways filling the bags, which must then be hoisted above deck, where from the holds on each side of the deck we propose to fit a portable rail along one side of the deck, say the starboard side, which will carry the bags of coal to the aft side of the heel of the slewing jib, where a feeding ring with a series of scores cut in it is kept revolving round the slewing jib, and will carry each bag in its turn from the after side of the jib to the fore side, where the hook in the hoisting gear before referred to will catch the hook on the bag and so hoist it to the head of the jib. The portable rail referred to will pass across the deck abaft the jib and, being continued along the port side of the deck, will enable the empty bags to be transferred aft to the various hatchways to be refilled, and the same operation to be again performed. If the collier or cargo steamer were a large vessel it would be well to fit a slewing jib at the after end also, and thus supply two vessels at the same time, one ahead and one astern. This arrangement would obviate the necessity of carrying the coals from the after hold over the bridge deck, which is generally built over the engine and boiler room. One of the objections raised to the tension weight has been that there would be a tendency to draw the collier to the battleship and thus allow the weight to come to rest at the bottom of the slewing jib, when the tension would, of course, cease; but in such a case it would be easy to put the helm of the collier over a few degrees, when the required resistance would be obtained. The jib being capable of slewing, the tension line would always lead fair from one vessel to the other, even if the collier was towed off the quarter of the battleship; in fact, if occasion arose, the collier could coal equally well from her broadside to the battleship.

With regard to the bagging of the coal the writer believes the usual method of filling the bags from the open hatches of the coal lighter to be a very primitive one. A large quantity of coal can no doubt be put into the bags by hand, but the greater quantity has to be lifted by shovel, and the men are exposed to the sun, rain, and at times bitter winds, dangerous to health—and a slow method withal.

A twin screw collier has therefore been designed with special provision for bagging the coal more rapidly and with more comfort. The following particulars are for a vessel to carry 5,000 tons of coal with a speed of 15 knots: Length 450 ft., breadth 50 ft., depth 36 ft. 9 in., draft 26 ft., displacement 11,000 tons; propelling machinery, twin screw triple expansion, of 5,600 i.h.p. for the above speed. These dimensions can, of course, be varied to suit the requirements of the service. In this design the "Express" transporter gear was placed forward and the propelling machinery right aft, so that the whole of the coal should be carried forward, giving a clear run for the coals from each of the holds forward to the slewing jibs or transporters. The space forward of boiler room was divided into four athwartship compartments, which, with the middle line bulkhead, will make eight compartments in all. These compartments will be fitted each with a steel sloping roof forming a tunnel, the roof stopping about 3 ft. 6 in. short of each side, which will leave an opening 54 ft. long and 3 ft. 6 in. wide, down which the coal will pay by its own gravity on to a bench running the whole length of the space. At the front of these benches the men will be stationed filling the coal bags, which are suspended on two horns, the coal being raked by hand into the bags. The bags, when filled, are hooked on to an overhead rail and run to the fore end of the compartment to be transferred to a hoist, which will carry them to the upper deck where they will be again carried on rails to the heel of the slewing jib or transporter as before described.



BY

J. C. R. ADAMS.

The previous article showed the conditions to be observed in designing a successful portable steam engine. The author now proceeds to give practical illustrations from leading types of modern engines. The series will be continued in the following issue.—ED.

II.

HAVING last month noticed at some length the leading features to be considered in the design and construction of a successful portable engine and boiler, we shall now have the opportunity of seeing how far the requirements we have sketched out are fulfilled by the principal manufacturers in this country, some of whom have turned out in their time twenty, forty, and even sixty thousand locomobiles. They have put into their work, as it went on, the results of accumulated experience, tending always towards simplicity.

The fads and eccentricities common thirty years ago have all disappeared, and with very minor differences in detail, as an inspection of our engravings will show, the present day locomobile has settled down into a permanent type—the product of independent methods converging upon a central idea.

With a view of presenting each firm's specialities upon a common basis for purposes of comparison, the engine we illustrate in each case is understood to be the 8-h.p. single-cylinder pattern, exactly as made and sold, without any extras whatever.

MESSRS. CLAYTON AND SHUTTLEWORTH, LTD.

In dealing with the eight or ten prominent firms whose manufactures we shall attempt to describe, we begin, appropriately enough, with the name of Messrs. Clayton and Shuttleworth, Ltd., of Lincoln, the oldest house in the trade, to whom, we believe, the credit of introducing the typical portable engine upon a commercial scale is due.

We have already mentioned the flush-topped boiler, which is one of the characteristic features of Messrs. Clayton's engines, and we may further note in passing that they do not adopt the modern screwed longitudinal boiler stays, adhering to the older and less direct plan of securing the stay rods by means of a pin-connection to pairs of angle-irons riveted inside the end plates.

Messrs. Clayton and Shuttleworth's cylinder is shown in figs. 5 and 6. As will be seen, it is effectively steam-jacketed, the steam passing through the jacket on its way to the starting valve C, the latter being a sliding shutter or valve, worked by a long wrought-iron lever. The steam is admitted to the cylinder through the small elbow pipe J, "which forms the only steam joint with the boiler, and can be removed without disturbing any other part." The construction of the cylinder, with all its details, is so clearly shown in figs. 5 and 6 that we need not dwell further upon it. The planed cast-iron saddle to which the cylinder is secured is bolted to the boiler, as also are the two cast-iron crankshaft brackets. Messrs. Clayton and Shuttleworth have not yet adopted the principle of forming these details in steel and riveting them to the boiler.

The attachment of the crankshaft plummer-blocks to their brackets is shown in detail in fig. 7. Both plummer-blocks are rigidly stayed by tie-rods, the right-hand one, in the usual way, to a lug on the cylinder; the left-hand one to a point on the firebox casting—a method peculiar, we believe, to Messrs. Clayton and



FIG. 4. MESSRS. CLAYTON AND SHUTTLEWORTH'S PORTABLE STEAM ENGINE.

Shuttleworth. The expansion of the boiler, and consequent movement of the brackets under the plummer-blocks, is provided for by the enlarged D-shaped holes, through which the two bolts of similar section (seen in the lower part of fig. 7) pass, connecting the plummer-blocks to the brackets.

The crank-bearings, of gun metal, are made in three parts, fitted with inclined external faces, bearing against adjustable wedges.

By easing screw C, and tightening screw B, the bottom part is raised, and by drawing up either or both of the side wedges, the alignment of the crankshaft can always be preserved, even though the brasses wear unequally.

Messrs. Clayton's adjustable eccentric for varying the steam admission to the cylinder is shown in fig. 8. It will be seen that the eccentric itself is not directly attached to the crankshaft, but is clamped to a fixed circular disc, across which it can be moved to the indications of the pointer, and tightened up

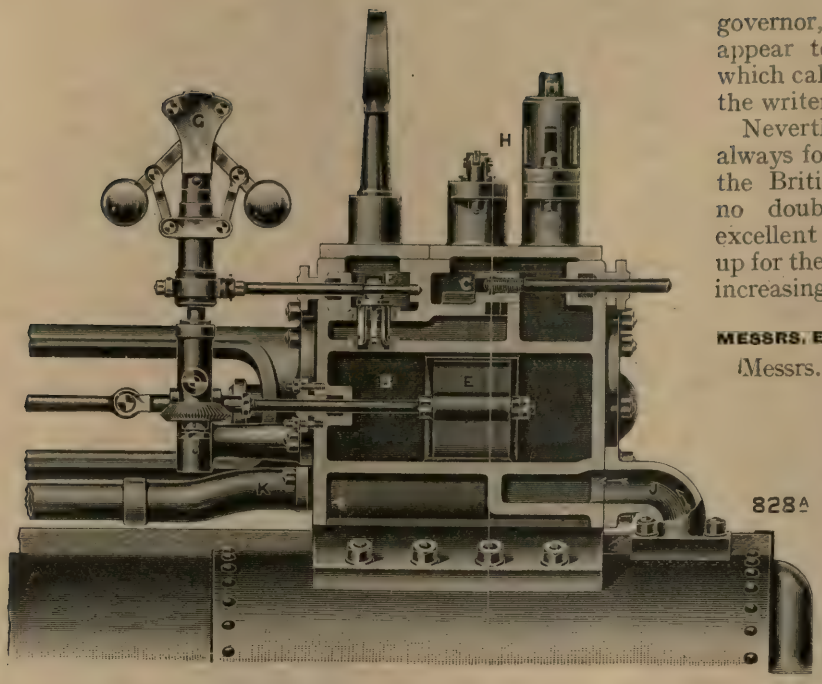


FIG. 5. SECTION THROUGH VALVE CHEST OF CYLINDER.
(Messrs. Clayton and Shuttleworth, Ltd.)

to give the period of admission required. The path of the eccentric in its movement across the disc is at such an angle with the crank that a uniform lead is maintained whatever the cut-off may be. The marking of the cut-off points is duplicated, so that variable expansion is obtained in whichever direction the engine is desired to run.

It should be noted that this engine is fitted with the now very generally adopted trunk guide to the piston-rod, the outer end of the trunk being secured to the boiler by a bolted bracket. Finally, the axles of the road wheels merit a passing notice, those for the hind wheels being attached to the firebox casing by circular flanges bolted on; the front axle being connected to the turn-plate by a species of universal joint which allows of the requisite movement in the fore-carriage when travelling over an uneven road

MESSRS. WILLIAM FOSTER AND CO., LTD.

Messrs. William Foster and Co., Ltd., of Lincoln, one of the four great firms having its headquarters in the locomobile metropolis, send us examples of their single-cylinder portable engines, from 2½ to 14 nominal h.p.

With the exceptions of the external steam inlet and starting valve and the high-speed governor, Messrs. Foster do not appear to have adopted designs which call for special comment by the writer.

Nevertheless, this engine has always found peculiar favour with the British farmer, and assisted no doubt by Messrs. Foster's excellent workmanship, has built up for them a large and continually increasing trade.

MESSRS. E. R. AND F. TURNER, LTD.

Messrs. E. R. and F. Turner, Ltd., of St. Peter's and Grey Friars' Works, Ipswich, are a firm of very old standing, who as far back as 1872 competed at the Cardiff trials of the Royal Agricultural Society with very marked success as regards economy of fuel, 2·9 lb. of coal per i.h.p. per hour being their official record.

For many years this firm, almost alone amongst British manufacturers, recognised the

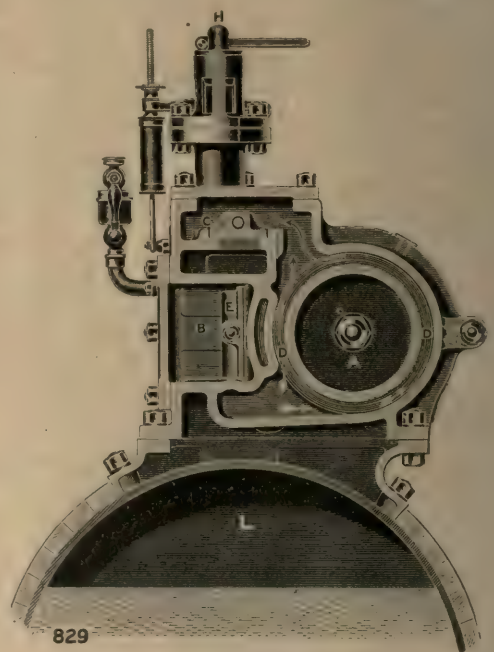


FIG. 6. TRANSVERSE SECTION OF CYLINDER.
(Messrs. Clayton and Shuttleworth, Ltd.)

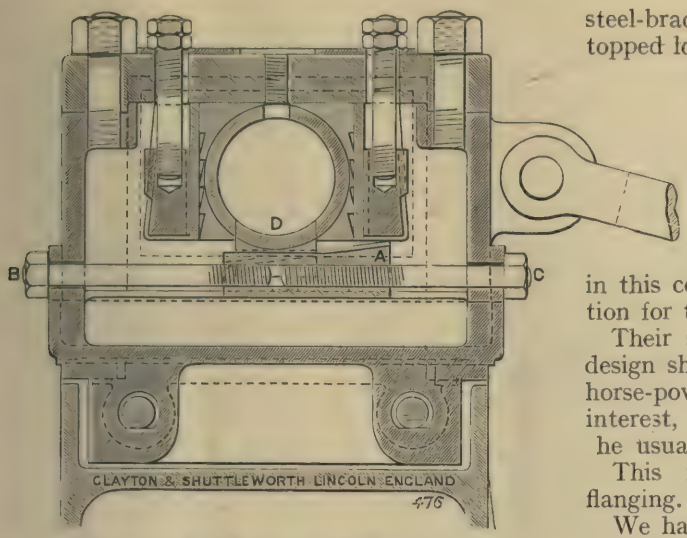


FIG. 7. CRANKSHAFT PLUMMER-BLOCK.
(Messrs. Clayton and Shuttleworth, Ltd.)

importance of a direct connection between crankshaft and cylinder, and what is more, regularly carried it out in their engines, not, it is true, exactly in the modern form, but in a manner so ingenious as to deserve placing upon record here. The crankshaft plummer-blocks were each mounted upon a narrow steel plate riveted edgewise to the boiler (*i.e.*, so as to present only a thin edge to the observer standing exactly in line with the crank shaft), thus forming an elastic (as distinguished from a sliding) crank bearing. From these extended to the cylinder upon each side a flat bar, forming a rigid stay, and absorbing all the pull-and-thrust stresses of the piston.

Really, except on the ground of appearance (the crankshaft supports being almost invisible on a strictly broadside view at some little distance away) it is difficult to imagine why this simple and effective arrangement should have given place to the more modern, but far less original, design shown in our illustration.

However this may be, Messrs. Turner have formed into line with most of their competitors, and their engine now exhibits no peculiarities. Even the Turner-Hartnell governor has gone by the board, leaving us with, it is true, a first-rate modern, steel-bracketed, detachable engine on a flush-topped locomotive boiler, but—well, an ancient landmark has disappeared, and we are half inclined to regret it.

MESSRS. RICHARD GARRETT AND SONS, LTD.

Messrs. Richard Garrett and Sons, Ltd., of Leiston, Suffolk, are amongst the oldest makers of portable engines in this country, and enjoy an enviable reputation for the excellence of their manufactures

Their single-cylinder engine is made in the design shown by fig. 11 from 6 to 14 nominal horse-power, and presents many points of interest, being an exception in many ways to he usual, or Lincolnshire, pattern.

This firm are specialists in steel plate flanging.

We have already illustrated their corrugated firebox, and now show their flanged steel saddle for the crankshaft plummer-blocks.

Messrs. Garrett do not, however, adopt the same idea in connection with the cylinder, the latter being bolted directly to the firebox casing by a heavy and stiff all-round flange, cast on the cylinder body. Neither do they make any use

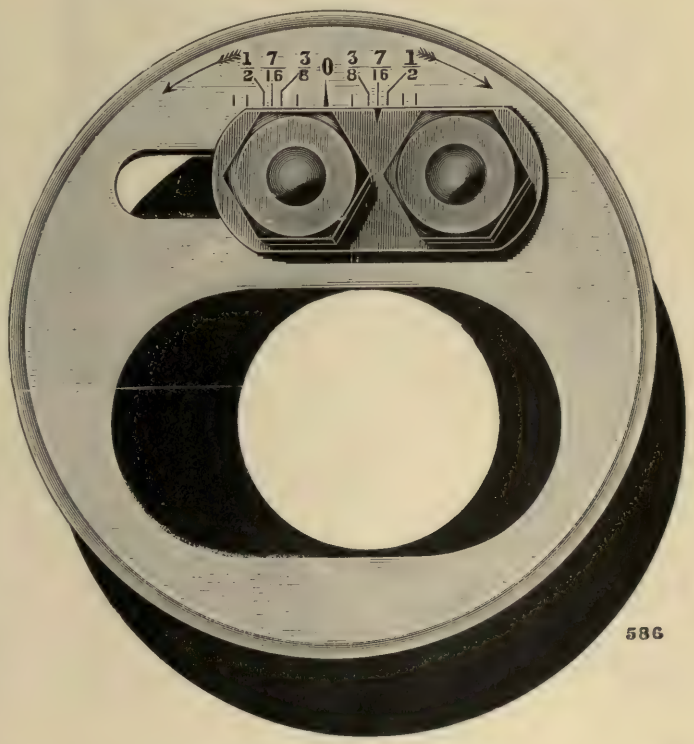


FIG. 8. EXPANSION ECCENTRIC.
(Messrs. Clayton and Shuttleworth, Ltd.)

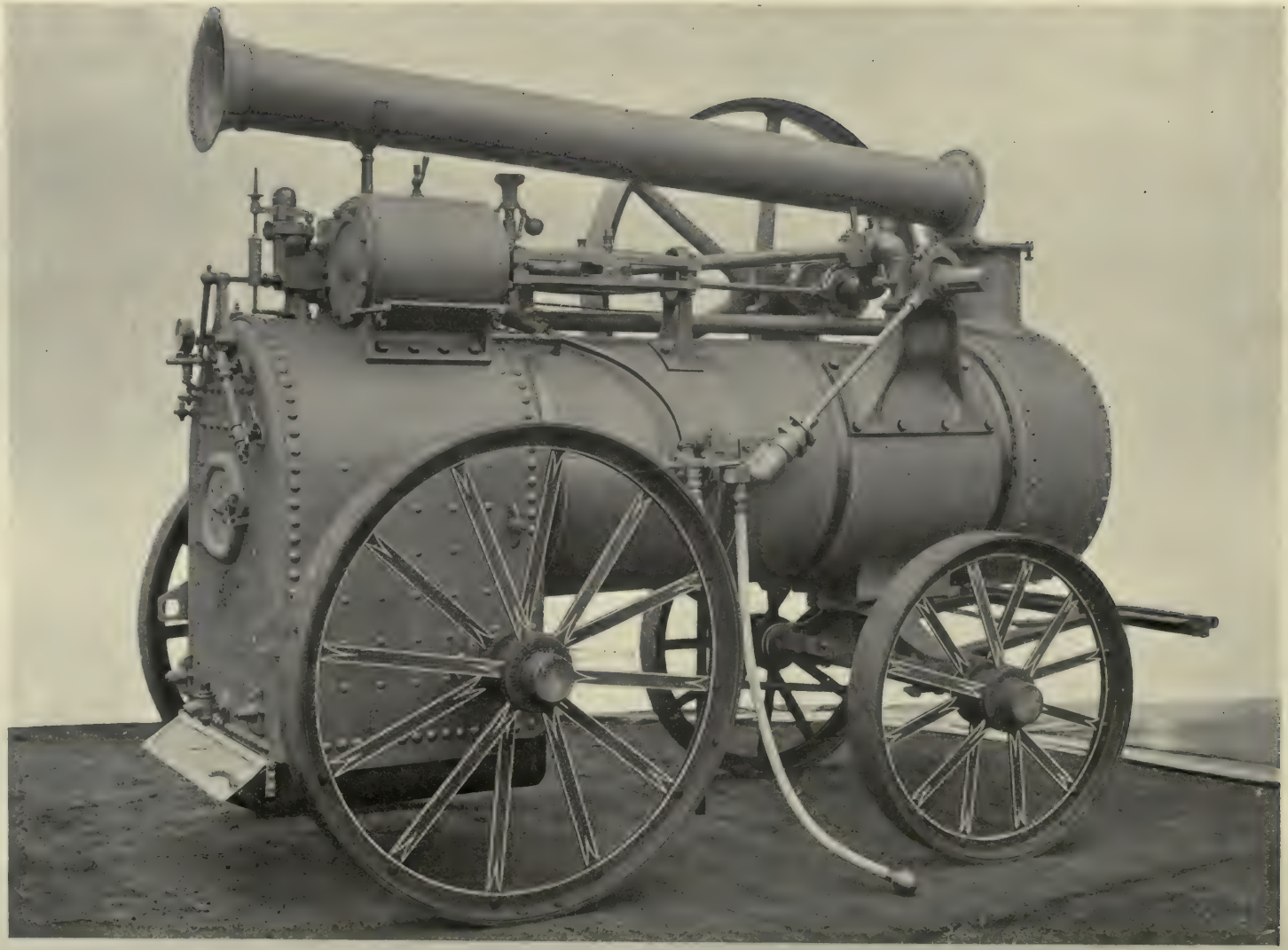


FIG. 9. MESSRS. WILLIAM FOSTER AND CO.'S SINGLE-CYLINDER PORTABLE ENGINE.



FIG. 10. MESSRS. E. R. AND F. TURNER'S PORTABLE ENGINE.

The brake to hind wheels is not part of the regular equipment.

of the stay-rod and sliding plummer-block system now so largely used.

To the steel crank saddle are strongly bolted, by both vertical and horizontal flanges, the cast-iron plummer-blocks, which carry two-part brasses and are inclined towards the cylinder at an angle of about 15 deg.

This angularity has the effect of placing the joint, or parting, of the brasses in such a position that, on the flywheel side both the weight of the wheel and the pull of the driving belt, are borne on the solid brass, while on the crank side the thrust of the crank shaft is taken on the solid only on the lower, or outward, stroke of the piston (assuming the engine to be "running inwards"). We certainly think that a vertical division of the brasses next the crank would—in principle, at any rate—be more correct.

We believe that this arrangement, so far as the portable engine is concerned, is peculiar to Messrs. Garrett, who are, amongst large makers, also alone in retaining the steam inlet underneath the cylinder, having apparently not adopted the modern plan of a separate external steam bend, the steam joints of which are visible and accessible.

The steam having entered the cylinder passes upward and around it, first to the starting valve, and then to a double seated throttle-valve controlled by a governor of the Pickering type (fig 13).

Messrs. Garrett publish a table of the results from this governor, showing a speed-variation of about 5·3 per cent. between a load of 20 b.h.p. and no load at all. The Turner-Hartnell automatic expansion governor is supplied without extra charge, when this method of controlling the engine is preferred.

Messrs. Garrett's feed pump (fig. 14), with the suction-chamber for drawing in a portion of the exhaust steam, and so raising the temperature of the feed-water, is an exceedingly neat and successful application of the injector principle to feed-water heating.

Turning now to the wheels and axles, we note that the Leiston engines have the turn-plate for the front axle riveted to the smoke-box instead of to the boiler barrel, as is usually the case. This gives a longer wheel-base, and does away with any possibility of leakage at the rivets, and so far is worthy of commendation. On the other hand, the lower part of the smoke-box is, perhaps, owing to alternations of heat and damp, the least durable part of the boiler, and is therefore not wholly to be trusted as a means of attaching the front wheels to the engine. The hind axles are admirably designed, being socketed into heavy cast-iron flanges, which are secured to the sides of the firebox by studs and nuts

MESSRS. MARSHALL, SONS AND CO., LTD.

Messrs. Marshall, Sons and Co., Ltd., whose works at Gainsborough, Lincolnshire, employ 3,500 hands, are manufacturers of locomobiles on a very extensive scale. Their engines embody all the essential details pertaining to the highest class of portable engines, and in neatness and finish are unexcelled. Fig. 15 shows their single-cylinder engine as made from 8 to 12 nominal horse-power.

The cylinder is mounted on planed steel girders, riveted to the firebox, with an external steam inlet. The flow of steam is carried round the cylinder and enters the valve-chest through the starting valve, which is situated at the top, thus ensuring a dry steam supply.

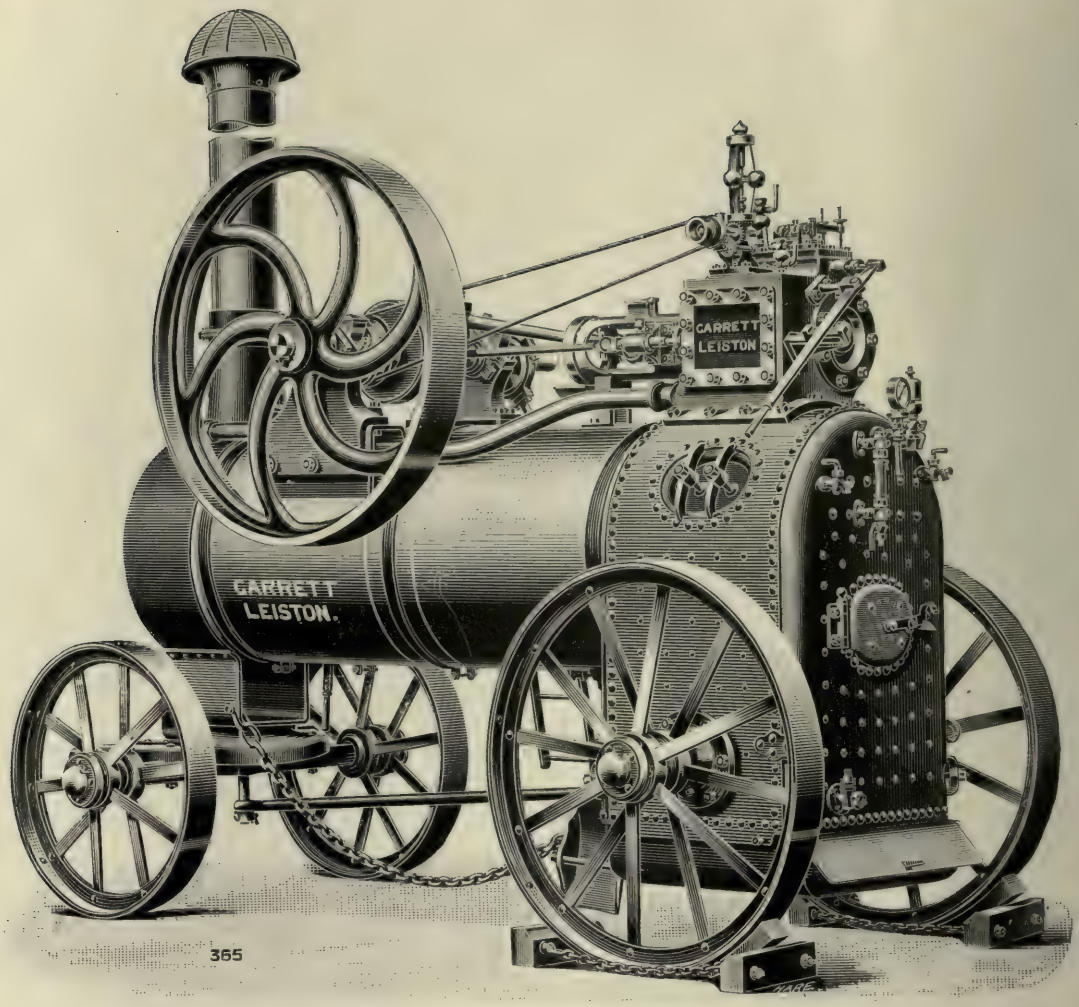


FIG. 11. MESSRS. RICHARD GARRETT AND SONS' (LTD.) SINGLE-CYLINDER PORTABLE ENGINE, WITH GOVERNOR OF THE PICKERING TYPE.

As usual with all the leading makers, the working barrel of the cylinder is a separate casting of very hard metal turned and bored and forced by hydraulic pressure into the body of the cylinder, the space between the two forming the steam jacket. This entirely supersedes the older method of casting the whole of the cylinder in one piece. The crankshaft brackets are each formed by a pair of steel plates riveted together, one flat and the other curved, both being double riveted to the boiler barrel. On the fly-wheel side the plummer-block is rigidly bolted to its steel bracket, but on the other side, next to the crank, the plummer-block is capable of sliding in a dovetailed groove, and is connected by a steel stay-rod to a lug on the side of the cylinder. This forms the provision for allowing the expansion of the boiler without affecting the working parts, and conversely for relieving the boiler of the stresses due to the pull-and-thrust of the engine. This arrangement of stay-rod and sliding plummer-block on one side only undoubtedly fulfils the latter purpose perfectly, but inasmuch as one plummer-block partakes of the movement due to the expansion and contraction of the boiler, whilst its companion remains unaffected by these alterations, it is evident that the crankshaft cannot always be exactly at right angles with the axis of the engine. Presumably, however, it is so adjusted as to be correct when the boiler is hot, which would really seem to be all that is necessary.

Messrs. Marshall's vast experience in the manufacture of portable engines is a sufficient guarantee of the practical success of this arrangement.

The feed-pump is not attached directly to the

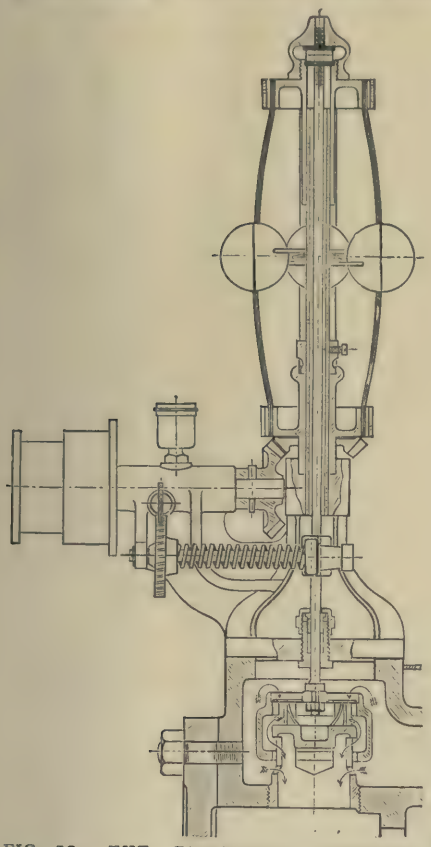


FIG. 13. THE PICKERING GOVERNOR. (Messrs. Richard Garrett and Sons, Ltd.)

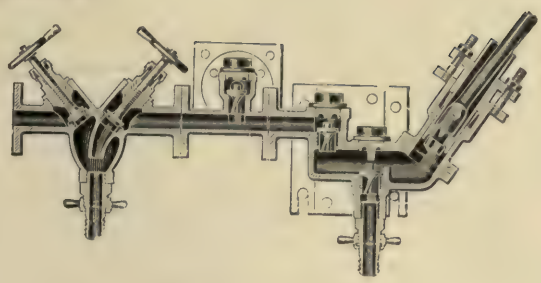


FIG. 14. FEEDWATER-HEATER (SECTION).

boiler plate, but to a steel flanged seating riveted thereto. Attention should be called to the ingenious fore-carriage, which is composed of a single flanged steel plate, in lieu of the wood or angle-iron carriage generally used.

The Marshall boiler is remarkable for the large radius of the rounded corners of the firebox, and is, it is needless to say, an admirable specimen of boiler work.

From 3 h.p. to 7 h.p. these engines are made exactly as the foregoing, but with the cylinder bolted to the boiler by a heavy all-round flange and steel riveted-on brackets to the crank-shaft without stay-rods.

(To be continued.)

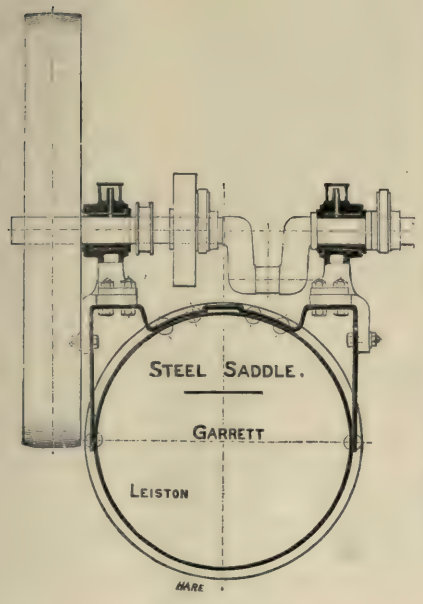


FIG. 12. FLANGED STEEL SADDLE.



FIG. 15. MESSRS. MARSHALL, SONS AND CO.'S SINGLE-CYLINDER ENGINE—MADE FROM 8 TO 12 NOMINAL HORSE-POWER.

OUR MONTHLY BIOGRAPHIES.

Prof. SILVANUS P. THOMPSON, D.Sc., F.R.S.

PROFESSOR SILVANUS P. THOMPSON, having been the Principal for nearly twenty years of the Finsbury Technical College of the City and Guilds Institute, has had to do with the training of a larger number of future electrical engineers than any one else in Great Britain. He was born in York in 1851, his father being one of the masters in the Friends' School, where he was educated. Before receiving his present appointment, Professor Thompson had been successively Science Master in his old school and Professor of Physics in University College, Bristol.

Professor Thompson's contributions to physics are numerous, and range over many branches, optics, magnetism, and electricity; but he is best known by his contributions to technical literature. He is the author of the most widely used elementary text-book of Electricity and Magnetism, also of books on the Electro-Magnet, and on Polyphase Currents. His standard work, "Dynamo-Electric Machinery," first published in 1884, is now in its seventh edition. It was in connection with this work that a libel suit was brought against Professor Thompson in 1902 by Dr. Henry Wilde, who claimed (being inventor in 1866 of the separately-excited dynamo) to be regarded as the inventor of the dynamo-electric machine. The action was dismissed, but Professor Thompson, while giving to Dr. Wilde's researches even more extended notice in his seventh edition, also demonstrated that a separately-excited dynamo had been invented by Dr. Sinsteden so far back as 1851.

Professor Thompson has published a life of Faraday. He has also busied himself with various patented applications of science, details of dynamo design, surface-contact tramways, and loaded cables for getting rid of the retardation of signals. His American patents for this latter invention have been acquired by Dr. Pupin. Professor Thompson's electrical library is one of the finest. Besides copies of all the editions of Gilbert's book, "De Magnete" (which he took part in translating), he possesses many other rare and early works. One of these is the only copy in private hands of the "Epistola de Magnete of Peter Peregrinus," printed in 1558. He also possesses two manuscripts of the same work, one of the fourteenth, the other of the fifteenth century. His collection of electrical pamphlets is probably unequalled outside the Ronalds library.

Professor Thompson holds the degrees of B.A. and D.Sc. of the University of London. He is a Fellow of the Royal Society, and an honorary member of other learned societies and Foreign Academies. He has been President of the Physical Society, of the Roentgen Society, of the Institution of Junior Engineers, and in 1899 of the Institution of Electrical Engineers.

(*See Frontispiece.*)

Sir LLOYD WISE, J.P., D.L., F.R.G.S.

SIR LLOYD WISE, who for the past thirty-four years has laboured incessantly in promoting reform of Patent Law and Practice, was born at Manchester in 1845. He received his early education in London and Ghent; this was followed by professional training in the office of his father —the late Francis Wise, M.I.Mech.E.—and subsequently he gained considerable useful experience in the works of Messrs. Siebe. He is a founder and original member of the Council of the Institute of Patent Agents, and has taken an active part in securing the following important reforms in the United Kingdom: the novelty examination scheme (of which he is the author), constituting the chief feature of the Patent Act of 1902; extension of the term of provisional protection; the dating of every patent (except those applied for under International arrangements) as of the date on which the application for it was originally deposited; reduction of fees; payment of fees by annual instalments; grace for payment of fees (subject to penalties); early publication week by week of illustrated abridgments of patent specifications; publication of illustrated abridgments in classes; publication of weekly reports of patent cases; registration of Patent Agents and their removal from the Register in the event of misconduct. This scheme mapped out in 1885, is approximately the one now in operation.

For a period of three years Sir Lloyd Wise was a member of the Southend local governing body, and chairman of several committees. Subsequently, in 1889, he was elected first County Councillor for the Southend Division, retaining office for nine years. For years down to the time when he abandoned County Council work, he was chairman of four important committees of the Essex Council.

A leader writer for over thirty years on the staff of "Engineering," he compiled the "Illustrated Patent Record," and the abstracts of Electric Lighting Patents in Dredge's "Electric Illumination." In 1891, being then President of the Institute of Patent Agents, he was, by Royal Charter, appointed first President of the Chartered Institute, and is now Senior Past-President.

Sir Lloyd Wise is a Fellow of the Royal Geographical Society; a member of the Royal Institution, of the Institution of Mechanical Engineers, and of the Iron and Steel Institute; an Associate of the Institution of Civil Engineers and of the Institution of Naval Architects; a member of the Patent Law Association of Washington, D.C. (U.S.A.), and a Foreign Member of the Australasian Institute of Patent Agents, and of "Le Syndicat des Ingenieurs Conseils en Matière de Propiété Industrielle" (Paris). He received the honour of Knighthood in June 1904.

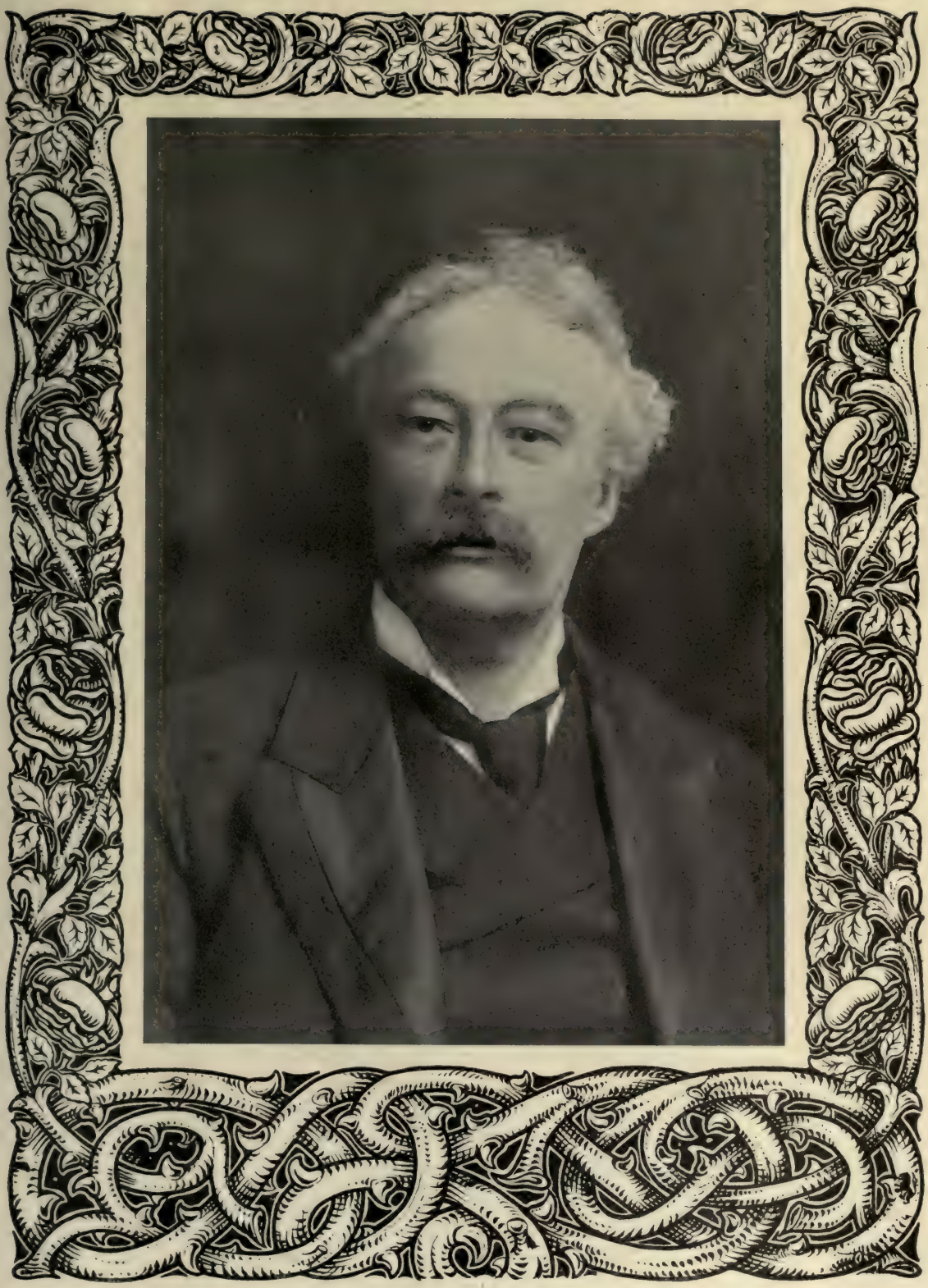


Photo by Elliott and Fry.]

SIR LLOYD WISE, J.P., D.L., F.R.G.S.

CATALOGUE COVER . . . . DESIGN . . .



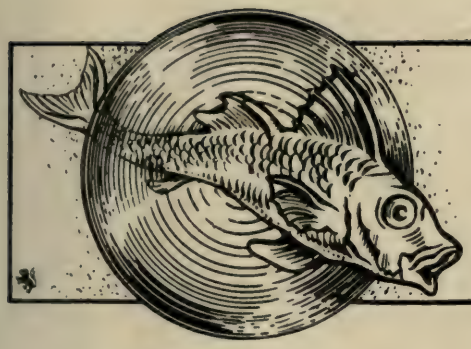
The Pulsometer Afloat.

A SMALL pamphlet, "For Ships' Use," issued by the Pulsometer Engineering Company, Ltd., Reading, bears a very striking emblematic cover, which is a good illustration of what can be done by the use of vigorous line work. The whole design is printed in a single panel, in black, upon light green paper, and a silken cord tied at the corner should help to prolong the life of the pamphlet, which is full of information on the subject of steam pumping machinery in vessels, diving apparatus, sirens, etc. The pamphlet has many excellent illustrations, one of which shows two No. 8 pulsometer pumps clearing water from the bilges of a wrecked vessel.



A Machine Tool Catalogue.

The other design is an equally effective specimen of half-tone work. The prevailing tint is a greenish gray, but the lathe stands out boldly from a white panel. In the framework, the artist has succeeded in producing a thing of beauty, and the design has been skilfully modelled in order to throw into prominence the name of the firm, and the words, "High Grade Machine Tools."



"P.M." MONTHLY ILLUSTRATED NOTES.

Ward and Wragg's Universal Notching Machine.

THIS machine, which is being put on the market by Messrs. Thos. W. Ward, Ltd., Albion Works, Sheffield, takes its name from the amount of notches it will cut in sections of joists, angles, tees, etc.

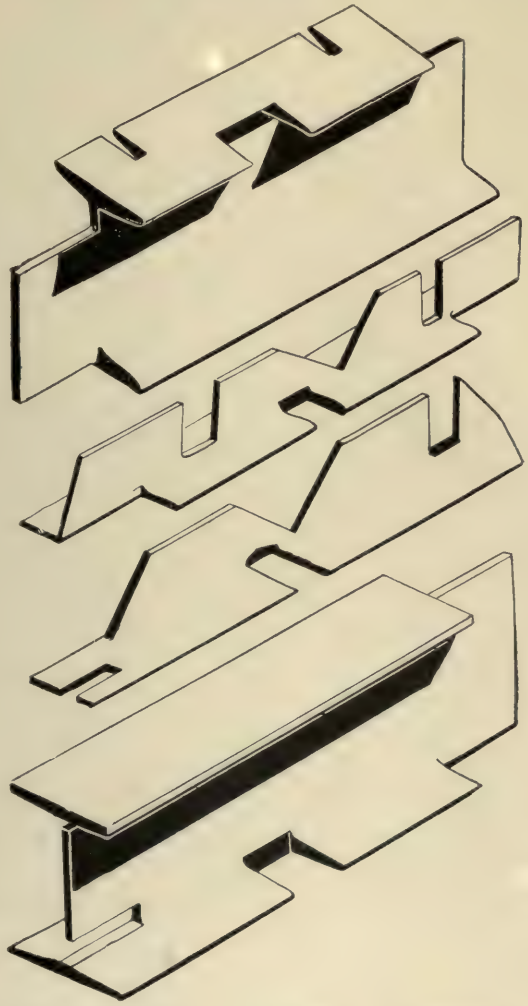
The machine is of the heavy punching and shearing machine type, with a specially deep gap, the gap being made to receive special tools, which tools consist of steel blocks, fitted with steel blades, having several cutting edges, all of which are movable to allow for the cutting of various notches. But a special feature of the machine is that a large and varied number of notches can be cut without changing any tools, as it is only necessary to change these for a few special notches. Such change of tools, moreover, only occupies a few minutes.

The machine notches joists in any required shape to suit any connection, all selections up to 10 in. by 5 in. It will notch, sever, or bevel, all sections of tees and angles up to 6 in. by 6 in. by $\frac{3}{4}$ in.; and will notch or sever all sections of channels up to 12 in. by 4 in. The work is cleanly cut and requires no smithing after leaving the machine. Specimens of joists cut by the machine are illustrated herewith.

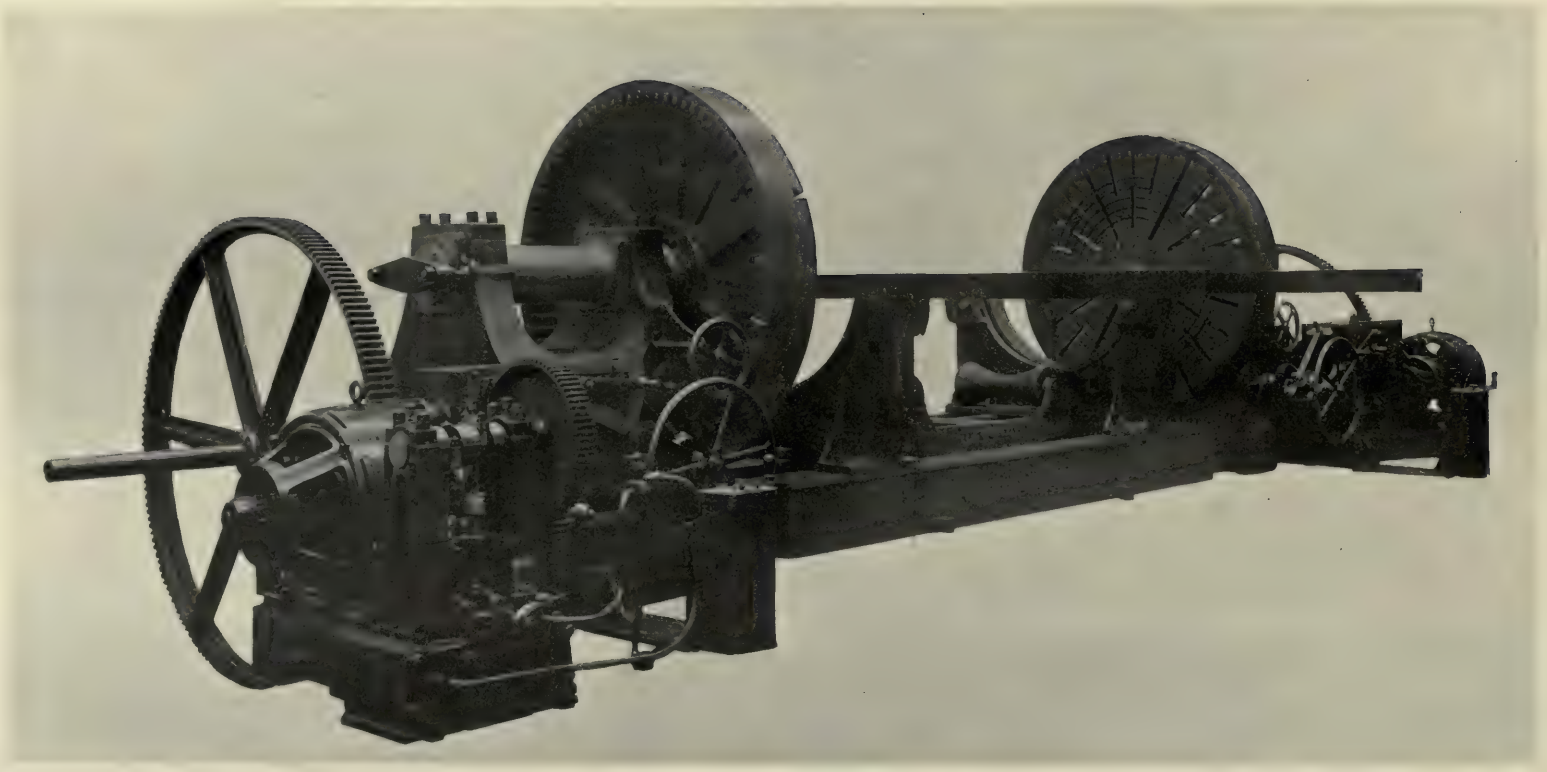
The need for a labour-saving tool of this description for shipyards, bridge builders, and constructional steel works has long been felt, and the new tool has already received a warm welcome at the hands of practical men.

Improved Pipe-Boring and Turning Lathe.

This lathe is designed by Mr. George Addy, M.I.Mech.E., for boring and turning pipes of the spigot and faucet type up to 48 in. in internal diameter, and from 9 ft. to 15 ft. long. As will be seen, each head-stock is driven independently, the motors being of 15 b.h.p. The motion is controlled by a special reversing mechanism of the drum type, there being obtained by it six speeds in either direction. In addition to these six speeds of the controller, there are three more speeds obtainable by change gear, so that in all there are



SPECIMEN JOISTS CUT BY WARD AND WRAGG'S UNIVERSAL NOTCHING MACHINE.



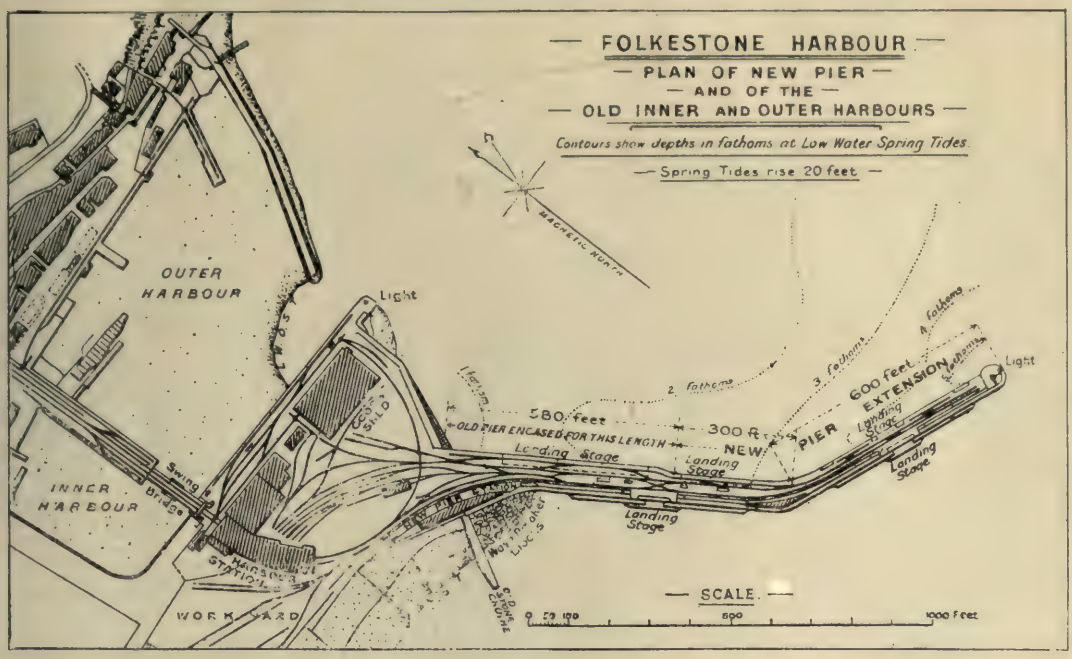
IMPROVED PIPE-BORING AND TURNING LATHE, BY MR. GEORGE ADDY.

eighteen speeds on the spindle. The feed motion is self-acting, variable, and reversing, there being three changes. The headstocks can be quickly moved by hand in either direction.

A notable feature in the design is a hydraulic ram fitted in the centre of the bed. This ram carries a cradle, which receives from an inclined way the pipe to be operated upon. The ram is raised or lowered by pumps, actuated by the electric motor. The usual practice is for the pipe to be rolled down the inclined way until it is over the centre of the bed, the hydraulic lift being then put in motion, raises the pipe clear of the inclined way, and then lowers it into position for turning and boring, the cradle sinking down clear until the operations are completed.

The ram then comes up and lifts the pipe on to the ways, upon which it rolls into the railway truck. The arrangement will be seen to be a very convenient one, and, whilst the need for cranes is obviated, the work can be handled with greater convenience and despatch than when the ordinary methods are adopted.

This machine-tool is believed to be the largest electrically-driven pipe-boring and turning lathe in the country, the pipes on which it is designed to operate being as much as five tons in weight. It will give some idea of the massive nature of the construction to say that the face-plates alone weigh 6 tons, and the spindle bearings are 12 in. in diameter by 12 in. long. The total weight is over 28 tons.





A VIEW OF THE NEW PIER AT FOLKESTONE.

On July 12th, the French Ambassador laid the last stone of the Folkestone Harbour Extension Works, which have been completed by the South-Eastern and Chatham Railway Company, at a cost of nearly £500,000. (See page 167.) For the above plan and photograph we are indebted to the contractors, Messrs. Coode, Son and Matthews.

The Structural Alterations and Extensions at Leeds Central Station.

A RECORD feat has just been accomplished by Messrs. Graham, Morton and Company, in connection with the structural alterations and extensions carried out at the Central Station, Leeds. These alterations have been necessitated by the congestion of traffic, augmented by the exercise of the running powers claimed by the Great Central Railway, and conceded by the Railway Commissioners' over the Great Northern and Lancashire and Yorkshire lines. Some idea of the state of congestion may be gathered from the fact that six hundred passenger and goods trains pass the "B" signal box, just outside Leeds station, during twenty-four hours.

Prior to the alterations and extensions, it was necessary, owing to limited space, to detach the greater number of locomotives from their carriages, turn them round, and re-attach them. Arrivals could only take place at one platform, and, even in wet weather, passengers, other than those arriving by local trains, were obliged to walk up an uncovered platform, after an annoying wait immediately outside the station. It was quite clear that this state of things must be abolished, and the authorities interested decided that a new arcade should be built which would give a new platform, while other platforms were to be lengthened, and the whole of the platforms roofed-in. The space to be covered was thirty-six thousand square feet, and the time given for the carrying out of the work was nine weeks and three days.

Messrs. Graham, Morton and Company succeeded in completing the whole of the work within one month from the letting of the contract, the Whitsuntide holidays notwithstanding. The quantities of material erected, and the area covered, were as follow: 26 principals, 36 columns, 36 cantilevers, 15 lattice-girders; total weight of iron-work 118 tons. The area covered by glass amounted to 5,800 square feet, some 462 separate panes being employed. The working area of station and platform covered amounted to 28,700 feet. The area of Vielle Montagne zinc used for covering was, approximately, 12,500 square feet. The area of the tongued and grooved match boarding used was 15,500 square feet. In addition to the large purlins, timber frame work, special canopies and special mouldings were used in the construction of the work.

With regard to the time occupied in carrying out the contract, it is to be noted that the contractors received the order at 4.30 on the afternoon of Friday, May 20th, just before the commencement of the Whitsuntide holidays. As business was suspended on account of the holidays, and the workshops were closed, operations were not started before May 25th.

The erection of the iron-work commenced at 10.30 on Saturday night, June 4th, and by 6 a.m. on Monday, June 6th, the first section of the work necessary to the carrying out of the first part of the contract was completed, the time taken being precisely 30 hours.

The second part of the contract was commenced at 10.30 p.m. on Saturday, June 11th, and by noon on Sunday, June 12th, the last piece of iron-work was lifted into place; that gives 12 working hours additional to the 30 hours of the previous week, making a total of 42 working hours.

The whole of the work was completed by six in the morning on Monday, June 20th, so that taking the date of commencement of the erection as the night of the 4th June, it will be seen that the actual period occupied by the carrying through of the contract from the time that the erectors were upon the ground was less than sixteen days. It is interesting to note that the time limit fixed for the completion of the contract did not expire until July 25th.

In the reorganisation of the Company's works, to which we recently called attention, and in such work as that accomplished at Leeds Station, Mr. Maurice Graham has done something to show that English engineers, at any rate, are fully alive to the necessity of efficiency, and are quite able to hold their own against all comers.



LEEDS CENTRAL STATION ALTERATIONS.

View from signal box outside the station.



ANOTHER VIEW OF LEEDS CENTRAL STATION.

The contract was completed sixteen days after the commencement of the erection.

A NEW OIL SEPARATOR.

EVER since surface condensers have been used the question of the oil in the condensed water has been a most important problem to all engineers. With low steam pressures there was not the trouble that there is now, where high steam pressures are in constant demand. The old imperfect methods for extracting the oil from the water are being rapidly abandoned. When the steam is condensed while still containing the oil, the discharge from the air pump is a white, milky emulsion, and while the heavy globules of fatty matter can be taken out by passing the water through towelling, fibre or other similar material, yet the oil which forms the emulsion cannot be so extracted unless it is allowed to stand in a tank and the oil is thrown down by chemicals. This method has three drawbacks :—

1. The cost of the apparatus and the constant attention required.
2. The space occupied by such a plant.
3. The cooling of the water and the expense required to raise it back to its original temperature when discharged from the air pump.

These methods, therefore, of dealing with the oil in the condensed water have had to be abandoned and the oil dealt with at an earlier stage, namely, in the exhaust steam itself. Here, again, several attempts have been made

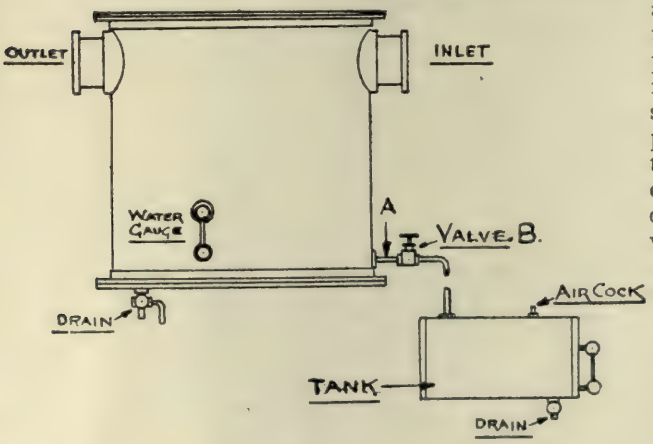


FIG 1.

by placing in the exhaust pipes wings or vanes that give the steam a swirling movement or cause it to take sharp turns with the object of removing the globules of oil in this way. Experience has proved that this is not feasible, as the velocity of the steam is too great to give up any of the oil globules, and loss of vacuum results owing to wire drawing the steam.

We illustrate a new design of separator recently invented by Mr. J. Arthur Reavell, of the Blake and Knowles Steam Pump Works in which these difficulties have been successfully overcome. After many experiments it was discovered that it was not until a large chamber was used that the results were more satisfactory, and it was found possible to extract the oil.

When the exhaust steam has passed into the chamber, the velocity is immediately lowered, and the oil, having a heavier specific gravity than the steam, gives itself up to the obstructions that are placed in its path. In some instances, these baffles were in the form of solid rods, angles or other substances, but in practice it is found that when enough of these are used to extract all the oil, the area between these baffles being reduced causes wire drawing so that there is a difference of vacuum between the inlet and the outlet of the separator which defeats the object of the condenser itself. The design of baffle which gives the most surface is that of the angle : this type is adopted in the separator under consideration. This patented and registered baffle is designed so that the area through each baffle for the passage of the steam is very great. The special angles are arranged in rows, one immediately behind the other, so that when one looks through two rows it appears to be a solid substance, while in reality there is a large area for the passage of steam. When the exhaust steam enters the separator it passes down to the water at the base, and thus is distributed in the chamber, as shown in section fig. 3. It then passes through the patent baffles where the oil is extracted and the cleansed steam is then taken to the condenser. When the oil globules are deposited on the baffles they easily run down to the water at the base, owing to the special way in which the perforations in the baffles are effected.

The size of the separator depends entirely on the amount of steam that is passed through it, and not on the size of the exhaust openings. The capacity of the separator is thus one of the essential features, and although there are some circumstances where large-sized expansion separators cannot be easily fixed, yet, owing to the fact that the exhaust inlet and outlet openings can be fitted in almost any position, these situations are few.

The draining of the separator is effected by a tank or pump; for small sizes a tank is all that is necessary, and fig. 1 shows the arrangement of piping for this. The pipe A connects the separator to the tank, and is fitted



NEW OIL SEPARATOR BY THE BLAKE AND KNOWLES STEAM PUMP WORKS.
(Invented by Mr. J Arthur Reavell.)

with valve B. The drain tank is fitted with a gauge glass and drain cock. To empty the tank, valve B is closed : the air and drain cocks on the tank are opened, then when empty the air and drain cocks are closed and the valve B very slowly opened until a vacuum is formed : it is then fully opened.

Another method is effected by means of one of the firm's vacuum pumps, shown in fig. 2. The pump is kept running at constant speed so as to extract all the oil and water that is deposited in the base of the separator, and it can then be discharged into a tank, or where it may be required. As one of Messrs. Blake and Knowles' improved type of vacuum pumps is used for this work it is immaterial if the pump is running at a slightly increased speed than will extract the water and oil, as in this case it will be simply pulling on the vacuum main.

These oil separators are constructed either cylindrical or rectangular from a shell 1 ft. 6 in. in diameter dealing with 250 lb. of steam to a 7 ft. 6 in. diameter shell, of 50,000 lb. capacity per hour.

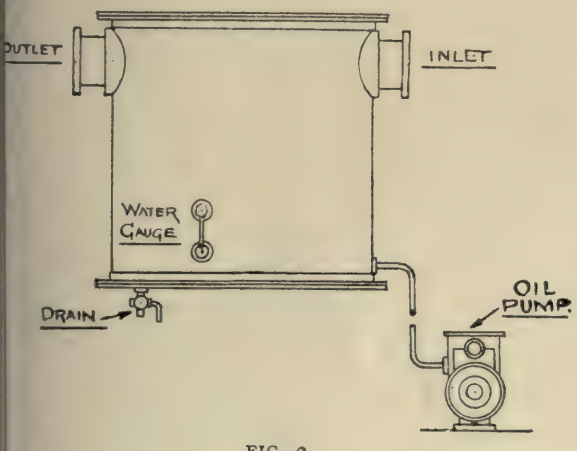


FIG. 2.

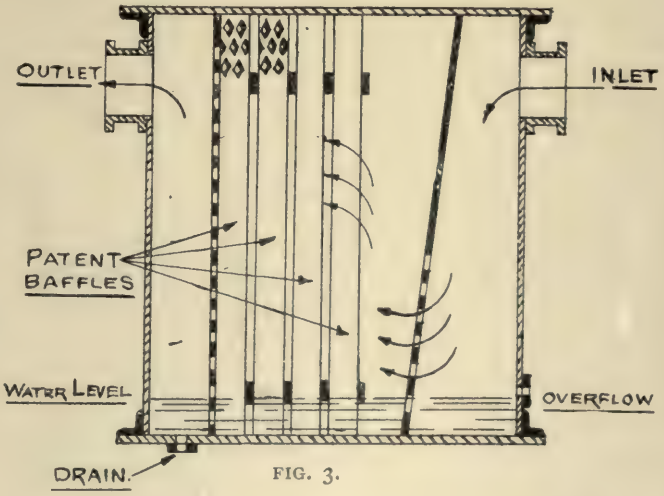


FIG. 3.



THE NEW TURBINE STEAMER "LONDONDERRY."

SHIPBUILDING NOTES.

The Shipbuilding Half-year.

The shipbuilding half-year, which terminated on June 30th, turns out to have been better in respect of output than was at one time anticipated. Scotch shipbuilders launched 169 vessels, aggregating 201,633 tons, as compared with 139 vessels of 208,441 tons in the first half of last year. The decline was, therefore, not much in Scotland, but the total is the smallest first-half total since 1897, when the record was only 159,450 tons. The Clyde proportion for the past six months was very close indeed to the corresponding total last year: viz., 187,363 tons, as against 187,796 tons. The output of the English yards in the six months, and of the Irish yards, makes up a total for the whole United Kingdom in the six months of 597,220 tons, as against 565,340 tons in the first half of last year. This, of course, represents a large amount of work, and it represents work of a very mixed character including warships as well as cargo tramps, and palatial liners as well as hopper barges. But the current half year, as we have already pointed out, does not hold much promise. The flow of orders has come to very like a stop, and in the month of June, the contracts booked by the whole large group of Scotch shipbuilders did not exceed 15,000 tons. July and August are very much of holiday months, and if there is no revival of demand by September, the outlook for the winter will be depressing.

The World's Shipping.

The new issue of "Lloyd's Register Book" contains a number of tables of the world's shipping in the current maritime year, 1904-5. As these tables differ from the statistics of the several countries, it should be noted that Lloyd's returns apply only to steamers of 100 tons and upwards, as registered; that they relate to the gross tonnage of steamers and the net tonnage of sailers; and that they do not include the wooden tonnage on the great lakes of America. The following is a summary of the world's tonnage:—

WOOD VESSELS..

No.	Net Tonnage	Gross Tonnage
1289	264,900	419,956

COMPOSITE VESSELS.

No.	Net Tonnage.	Gross Tonnage.
195	46,396	72,827

IRON VESSELS.

No.	Net Tonnage.	Gross Tonnage.
5684	3,056,734	5,067,025

STEEL VESSELS.

No.	Net Tonnage.	Gross Tonnage.
11,299	14,324,111	23,072,876

Analysing in the same way the tables referring to sailing vessels give the following results:—

WOOD VESSELS.

No.	Net Tonnage.
8201	3,035,654

COMPOSITE VESSELS.

No.	Net Tonnage.
75	47,584

IRON VESSELS.

No.	Net Tonnage.
1195	1,280,293

STEEL VESSELS.

No.	Net Tonnage.
1352	1,792,974

The total is 34,741,605 tons, of which very nearly one-half, or 16,580,845 tons, is under the British flag: viz., 15,391,350 tons in the United Kingdom, and 1,189,495 tons in the British Colonies. America

comes next with 3,849,399 tons, and Germany third with 3,369,807 tons. No other nation comes up to two million tons. The following compares the totals of the different countries with the corresponding figures of last year :—

Flag.	Tonnage. 1903.	1904.
British	16,006,374	16,580,845
American	3,611,956	3,849,399
German	3,283,247	3,369,807
Norwegian	1,653,740	1,717,654
French	1,622,016	1,693,366
Italian	1,180,335	1,187,566
Russian	809,648	840,515
Spanish	764,447	754,855
Japanese	726,878	661,417
Swedish	721,116	751,533
Dutch	658,345	687,529
Danish	531,247	598,984
Austro-Hungarian	518,697	585,066
Greek	378,199	401,208
Belgian	157,047	162,944
Brazilian	155,086	163,980
Turkish	154,494	153,667
Chilian	103,759	99,885
Portuguese	101,304	99,001
Argentine	95,780	88,791
Chinese	60,000	62,655

British shipping has thus increased in the year by 574,000 tons, American by 237,000 tons, German by 86,000 tons, French by 71,000 tons, Norwegian by 64,000 tons, and Russian by 39,000 tons.

The World's Greatest Ships.

In the building of ships of colossal dimensions, there appears to be no limit. At the end of the nineteenth century, the number of merchant vessels of 10,000 tons and over was under half a dozen, but since then huge steamers have multiplied to a great extent, and at present they are not far short of one hundred. More than half belong to this country, and are employed in trade with the United States. Germany already possesses twenty-six steamers of over 10,000 tons each, and is preparing to build more. Ere long, Germany may aim at the construction of vessels that will rival the *Baltic* in dimensions, and the new Cunarders in speed. Such vessels do, however, put a great strain upon the resources of the ports of the United Kingdom and other nations. The creation of great ships has been quicker than the arrangements for their reception and berthing. The Clyde Trustees have been foremost in designing docks to meet the wants of the largest of steamers, and in obtaining the sanction of Parliament for widening and deepening the navigable channel by which these docks are approached. Other local bodies are doing the same. How far these big ships are justified by the condition of the ocean-carrying trade is doubtful. If they can obtain an ample supply of cargoes, their size has decided advantages, as their working expenses compared with smaller vessels are proportionally less. But such cargoes are not always obtainable and the ports which can take in these monsters are few.

American Shipbuilding.

The extension of the American coastal laws to the Philippines is expected to cause a considerable development in the shipbuilding industry of the United States. It seems not unlikely that the freight and passenger-carrying of the Pacific will pass largely to American vessels. Strong measures against the industrial trusts are being advocated by shipbuilders. The Cramp Shipbuilding Company, of Philadelphia, state that shipbuilders are at the mercy of the combination of the large plate mill interests of the country, who have established £8 per ton as a base price for steel plates, as compared with £5 to £5 10s. per ton in Great Britain. If these figures were the extremes in both countries, the difference in the case of a ship with 5,000 tons of structural steel is serious, and as America is anxious to become a Sea Power, the feeling against trusts is intensified by the amount of difference. The extra cost involved in the building up of the navy may assist in convincing the American people of the importance of reform. Some of the firms which entered the list for naval contracts are now grumbling because success has not been realised. The complaint is against the experience of the navy inspectors. Several firms have written to the Department on the subject, and one says that in most cases the inspectors are not at all qualified for the position. "Pretending to know everything, they know nothing, and alterations and additions demanded while the vessel is in course of construction, and for which the Government allows no extra compensation, are calculated to irritate the most peaceful and conscientious contractor. This department of the Government is tied up in a great deal of red tape, which nothing on this earth can apparently loosen." Somehow, this seems an echo of what is not unfamiliar on our own side of the Atlantic.

New American Warships.

The new battleships to be laid down for the United States this year will not differ materially from those of last year, although there is still some doubt as to the armament. In the later ships, America has adopted four 12-in., eight 8-in., and twelve 7-in. breech-loaders, and although the 8-in. weapon falls short of the 9·2-in. guns, of which our ships mount four, the 7-in. gun is preferable to our 6-in. quick-firers in power developed. Whether eight 8-in. guns are equal to four 9·2-in. guns is doubtful, in view of the greater range of the latter. The new American ships are to be limited to 16,000 tons displacement, with 900 tons of coal on board, and with the full load of 2,200 tons, and all war stores, the total will be 18,000 tons. But it is expected that the draught will not be more than 26 ft. 9 in. by having a length of 450 ft. with a moderate beam of 76 ft. 10 in.

PAGE'S MAGAZINE

An Illustrated Technical Monthly, dealing with the Engineering, Electrical, Shipbuilding, Iron and Steel Mining and Allied Industries.

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Editorial.—*All communications intended for publication should be written on one side of the paper only, and addressed to "The Editor."*

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OUR MONTHLY SUMMARY.

LONDON, July 20th, 1904.

Dr. Barton's Accident.

The way of the inventor is generally hard, especially if he has undertaken to produce any kind of flying machine, but to be brought to a halt by a painful accident just as one's plans are near fruition is, happily, less common, and would serve to exasperate most men. Dr. Barton, however, is not the type of man to be deterred by his recent accident from pushing his plans to a head, and we are sure that many will join with us in wishing him a speedy recovery, and success to the air-ship. Happily, the explosion which occurred while the doctor was superintending the inflation of his balloon with hydrogen, proved more alarming than disastrous, and in a personal note to the writer, dated July 15th, he says: "I am glad to say that I have had a most marvellous escape, and have also perfectly recovered my eyesight. My doctors, however, seem to think that a fortnight's change abroad will be necessary for me before undertaking the experimentary trials of the airship, and the directors of the 'Air-ship Syndicate' have, therefore, decided to postpone the first public trial until Saturday, August 13th."

British *v.* Foreign Patent Laws.

The "Repression of the British Inventor," alleged by Mr. G. A. Lowry, in the "Journal of the Society of Arts," has produced a prolonged correspondence, the latest addition to which is a letter signed Samuel E. Darby, ten years Examiner in the U.S. Patent Office. The writer does not hesitate to say that if the present conditions with regard to patents in England continue to obtain, the country will be "relegated to the rear, and left far behind in the race of mechanical achievements." It is pointed out that the advantage accruing to an investor under Patent Laws of the United States and Germany by reason of investigation as to novelty prior to the issuance of the patent, is that when the patent issues, the inventor or the owner therefore secures a grant which carries with it the presumption of novelty. This presumption requires proof to overcome it, or to invalidate the patent, of the same character that is required to convict a man of murder, that is, it requires proof beyond a reasonable doubt. A grant sustaining such a legal presumption is of the utmost value to inventors, in that the patent means something to the owner. It means that substantial rights are secured thereby. The inventor or the owner to whom the patent issues may use that grant as the basis of his business, in case he should himself enter upon the manufacture of the patented device. It forms the basis by which he may negotiate with confidence for the sale of the patent, or of rights and interests thereunder. No such presumption attaches to the issuance of a British patent. If

a patentee takes his British patent to a manufacturer for the purpose of interesting such manufacturer in the patented device, either in the sale of the patent, or of some interest or right thereunder, there is no assurance, neither to the patentee or owner of the patent, nor to the manufacturer, that there is anything in the patent which may be sustained or that may be of value as a protection against infringers. It does not cover such a right as would justify a Court in issuing a *pendente lite* injunction. It does not carry with it the legal presumption of validity or of patentable novelty, but only a mere colour of right.

The State of the Navy.

An important paper was read by Lord Brassey a few days ago, before the London Chamber of Commerce, on the state of the Navy and naval administration. He showed incidentally that in first-class battleships we as a nation are equal to a combination of three Powers. If ships building are included, and assuming an equal rate of progress, we are fully up to a two-Power standard. We are strong in cruisers of every type. We have maintained our maritime supremacy by an expenditure never before approached in time of peace. In a Parliamentary return of last session the cost of Imperial defence was given at £87,487,000. For the Navy the expenditure for the current financial year will be about £42,000,000. As to the possibility of the reduction of charges, the expenditure necessary to ourselves depends on the expenditure elsewhere. In the period 1895–1903 Navy Estimates for Germany were increased in round figures by £8,000,000, and in Russia by nearly £5,000,000; in both cases mainly for shipbuilding and armaments. The present indications are that competition on naval preparations is becoming less severe on the whole. If foreign Powers cut down we are ready to follow. It is hardly possible in these days to gain an advantage by superiority of design. Battleships equal to the most powerful of those building for foreign Powers are necessary for the British Navy, but a less costly type is also needed. For the general duties of the cruiser class second-class cruisers of the *Challenger* type, under 6,000 tons displacement, are effective, their cost being only £400,000, as against £1,100,000 for the *Duke of Edinburgh*. In regard to manning we have a permanent force far above a two-Power standard, but in reserves we have not reached that level. Lord Brassey accordingly suggests that the Admiralty should do more for the education of the young officers of the Naval Reserve, that regiments may be permanently quartered at the naval ports and trained as marines, and that stokers of tropical races should be enrolled in the reserves.

A New National Nautical School.

The admirable work carried on for many years in the Bristol Channel on board the *Formidable* will very soon be transferred to and continued on land, H.R.H. Princess Henry of Battenberg, having on the 15th ult. laid the foundation-stone of the new National Nautical School at Portishead. A statement made by the hon. secretary (Mr. Henry Fedden) showed that the *Formidable* has been used as a training ship in the Bristol Channel since 1869. Since that date about 3,600 lads rescued from homeless and wretched surroundings have been received on board under the Industrial and Elementary Education Acts, or as Volunteers, and from 70 to 80 per cent. have been sent into the Royal Navy, the mercantile marine, and naval and military bands; whilst others unfitted for sea life have been emigrated or found employment on shore, and about 350 boys are being trained on board at present. Some time ago the Government gave the committee of management notice that the ship, being out of repair, would no longer be allowed to remain in her exposed position, and for the past two winters the Admiralty requirements for the safety of the ship have been met by the employment of a steam tug lying alongside at a cost of £250 each season. The committee sought in vain for another suitable berth in the Bristol Channel, and when the decision had to be made between letting the work fall to the ground, and promoting a nautical school on land, they felt that their duty was plain. With substantial assistance from the Bristol and other education authorities, from the County Councils of Somerset, Gloucester and Wilts, from the Guild of Merchant Venturers at Bristol, and others, they have succeeded in raising £27,700 towards the £31,000 or £32,000 needed to complete the scheme. The scheme has been warmly approved by His Majesty the King, and also by H.R.H. the Prince of Wales, who some time ago sent a contribution to the funds.

The Royal Naval Volunteer Scheme.

For some weeks the sloop *Buzzard*, anchored in the Thames, has been one of the stock sights of London, and it will henceforth serve to remind the world that the Royal Naval Volunteer Scheme is an accomplished fact. Since we last went to press the London Division, some 700 strong, has been inspected by the Lord Mayor, who visited the *Buzzard* in company with Lord Selborne and other distinguished visitors. The present force has been established under the provisions of the Naval Forces Act, 1903, and certain Admiralty regulations. It may be called upon, in time of war, to serve wherever required, and with any part of his Majesty's Fleet, and in that important particular the conditions of service differ from those of the late Naval Artillery Volunteers, who were only liable to serve in the defence of the coasts of the United Kingdom. Recruiting commenced in September last, and already about 900 men have been enrolled in the London division, whilst recruits are still coming in freely. Officers and men of this division have been, and still are, drilling on board H.M.S. *President*, West India Docks, but, although a large number have qualified as efficients, the distance of the docks from the City has proved a stumbling-block in the way of efficiency and general progress. However, his Majesty's Government has now placed at the disposal of the London division, a drill and depot ship, and, by way of additional accommodation, the commanding officer has decided to take, on lease, a wharf situated on the Surrey side of the river, and almost

opposite to the ship. Here there is a large shed which, with some alterations and additions, can be made suitable for use as a drill hall.

Lord Selborne also inspected the Division a few days ago on board the *President*, and was able to express great satisfaction with all he had seen.

Cape Town Industrial Exhibition.

According to the latest programme the primary object of this exhibition, which is to be opened in November next, for three months, is to serve as a market. It is pointed out that Great Britain's share of the £52,500,000 of imports is nearly £28,000,000. South Africa is, therefore, Great Britian's second best customer, being only exceeded by India. With the rapid development of the country it is safe to assume that before another twelve months have passed South Africa will be Britain's best customer. More remarkable even than the growth of British commerce in South Africa is that of our American cousins. In three years America has nearly doubled her exports to South Africa, increasing from £3,886,673 to £6,313,459. Canadian and American manufacturers are carefully studying the requirements of the market, and British manufacturers must recognise the competition as real and serious, and, if they wish to retain the market, must be prepared to meet that competition. The development of municipal, as well as commercial, enterprises in South Africa is most marked. The recently-issued report of the Transvaal Chamber of Mines states that the total purchase by Rand mines of stores and machinery during 1903 was £5,242,622. During the period only two-thirds of the erected stamps were working. Now that the labour question has in a great measure been settled, the requirements of the mines will prompt the expenditure of vast sums of money. The large accession of foreign labour to work the mines must mean immediate increase in the demand for British manufactures. The report referred to states that on June 30th, 1903, the number of stamps at work was 7,145, employing 59,078 natives. In five years' time it is expected that the total number of stamps will be 18,260, and these will give employment to 368,637 persons.

German Waterways.

The "Railway Age" calls attention to the fact that five bills relating to waterways have been introduced in the Prussian Landtag, and are at present under consideration in that body. Four of these bills deal with the control of the current of streams, obstructions to navigation, floods, regulation of current, etc., while the fifth provides for the construction of new canals and the improvement of streams. The first bill appropriates 60,800,000 marks for regulating and improving the Oder, Havel, and Spree rivers. Of this sum the State Government is to provide four-fifths, and other interests provide the balance. The second aims to prevent floods in the province of Brandenburg. It is proposed to have the State construct the necessary works on account of the province, and to let the State assume an indebtedness of 1,864,000 marks out of a total estimate of 2,330,000 marks. The third bill proposes to fight floods and high water dangers in the valley of the Oder with an outlay of 60,000,000 marks, under the direction of the provincial president of Schlesien. The fourth bill is general in its nature, and aims to regulate the control of streams and flood districts throughout the empire. These four bills deal primarily with matters of general public interest, and are not likely to call forth much active opposition. It is different with the fifth. This bill proposes to expend 280,200,000 marks for the construction of canals and the canalisation of streams. The opposition to this plan promises to come chiefly from two sources: First, from those who do not believe in taxing the public for the benefit of special interests; and, second, from representatives of districts which will suffer from the proposed works or which do not secure corresponding advantages. There are those who believe that every system of waterways for which public funds are expended in considerable amounts should be made self-sustaining. It is the rule with some, on the other hand, that they need not concern themselves about the interest on the millions sunk in canals. On the relative merits of these two positions depend the future policy of Germany regarding waterways. The Government operates its railways on a paying basis. Shall the canals be released from obligations which the railways are expected to meet? Shall the Government of Prussia favour its left hand at the expense of the right?

The Limitations of the Trans-Siberian Railway.

At the third Russian Electrotechnical Convention at St. Petersburg, Count A. F. Lubienski discussed the desirability of adopting electric traction on the Trans-Siberian Railroad. The author stated that in the near future it will be necessary to operate 40 to 50 trains per day, due to the large number of emigrants to be carried and to the freight to be handled. The speed of the trains under present conditions is limited by light rails, by the bad profile of the road, and by lack of water. The last-named difficulty can be overcome by the construction of more suitable ducts or by using more powerful locomotives with tenders of larger capacity.

The elimination of the effect of the light rails and bad profile of the road, however, would necessitate an excessive expenditure of money and consume considerable time. It would prove much more economical to establish electric traction on some sections of the railroad. In this case the construction of the line would remain unchanged and high speeds could be attained even on sharp curves, the axles of electric locomotives being independent of each other, while the grades could be climbed without difficulty by increasing the number of axles. In the case of electric traction the question of water supply is not of great concern, for the central stations could be established in the neighbourhood of large lakes or rivers, at a distance of 75 to 150 miles from each other. In spite of the difficulties in obtaining

electric materials and supplies, and the necessity for a staff of technical men, which could hardly be found in Russia, it would be easier to adopt electric traction than to undertake the rebuilding of the whole line.

The International Electrical Congress.

The International Electrical Congress will be convened at St. Louis, beginning at 9.30 a.m., on Monday, September 12th, 1904. The opening ceremonies of the Congress will be held in the Music Hall of the Coliseum, at Olive and Thirteenth Streets. The meetings of the eight sections will follow, commencing at 11 o'clock a.m., in the section halls on the second floor of the Coliseum, the sections adjourning on Monday, at 1.30 o'clock p.m. On Tuesday, Thursday and Friday the sections will meet on the second floor of the Coliseum at 9 o'clock a.m., and will adjourn not later than 1 o'clock p.m. On Wednesday at 10 o'clock a.m. the Annual Convention of the American Institute of Electrical Engineers will be formally opened at Festival Hall in the grounds of the Louisiana Purchase Exposition, and the President of the Institute, Mr. Bion J. Arnold, will then deliver the annual address. Immediately afterward a topical discussion will follow between the Institution of Electrical Engineers of Great Britain and the American Institute of Electrical Engineers. Arrangements are being made for holding a closing meeting of the International Congress, and this will probably be held in one of the buildings in the grounds of the Exposition.

Railway Electrification in London.

The publication of a detailed illustrated description of the electrical installation for the Metropolitan Railway Company, in the current number of "The Tramway and Railway World," recalls the fact that the time is now close at hand when there will be in operation by far the greatest system of electric railways in this country.

It is anticipated, with a fair degree of confidence, that about the beginning of next year steam locomotives will disappear from the entire system of the District Railway Company and from the busiest sections of the Metropolitan Railway Company. This will mean that we shall have some 50 or 60 miles of heavy electric railway at work in London and the immediate vicinity, apart altogether from "tube" railways existing and in process of construction.

The two great power stations, one at Chelsea for the District Railway and associated "tube" lines, the other at Neasden for the Metropolitan Railway, are now in such a forward condition that their completion cannot be long delayed. Between them they will be able to produce some 60,000 or 70,000 horsepower, and provision is made for additions to this enormous total when required.

Fire Protection on Board Ship.

A propos of the disastrous fire at New York on board the excursion steamer *General Slocum*, it is interesting to note that Mr. E. O. Sachs has written a pamphlet entitled "Fire Protection on Board Ship," in which he has embodied the suggestions which he made at the Spring Meeting of the Institution of Naval Architects. "On that occasion," said Mr. Sachs, "I specifically mentioned that I scarcely thought much would be done to improve matters unless some calamity occurred involving many hundred lives. Such a calamity has now unhappily occurred, but I trust it will serve to bring about the adoption of such measures as are necessary to avoid the possibility of such a terrible loss of life again taking place."

The pamphlet forms one of the publications of the British Fire Prevention Committee.

Experiments at Port Melbourne.

Experiments have been made at Port Melbourne by the Iron, Steel, and Metals Manufacturing Company to prove the value of the patents of Messrs. M. Moore and T. J. Hesketh, for the direct production of wrought-iron and steel without the necessity of first producing pig-iron. An Australian correspondent sends me the following details from the "Melbourne Age." When the varying processes required to produce steel and wrought-iron from the crude ore are remembered it will be recognised that to secure the production of steel and wrought-iron in one operation without starting from pig-iron of uncertain composition would mean a tremendous step forward in the metallurgy of iron. Trial runs with New Zealand magnetic iron sand are now being made on a somewhat large scale. This sand is first separated from its gangue by electro-magnetic separators, this treatment leaving a pure magnetic iron oxide. The sand is fed from a bin into the furnace, which is entirely novel in its features, being chiefly mechanical and automatic in its arrangement. The ore drops from the bin into a slowly revolving cylinder, placed at such an angle that it travels forward continuously along it. As it does so t gets heated to a dull red heat by the waste gases from subsequent operations. From this cylinder the ore drops into a second revolving cylinder, where the fine particles are subjected to the action of reducing gases, which reduce the magnetic oxide of iron to the metallic form, at the same time permitting the particles to retain their individuality. From this second cylinder the reduced ore drops into a smelting bath at the bottom of the revolving cylinders, and the molten steel or malleable iron, as the case may be, is tapped from this whenever that operation is necessary. It will thus be realised that the process is one of great simplicity, and yet of much ingenuity. Not the least interesting part of the work being done at Port Melbourne is the use of liquid fuel for heating purposes.

AUTOMOBILE NOTES.

By J. W.

Motors for Men of Moderate Means.

Motoring first had its Badminton book in April, 1902, Mr. Alfred Harmsworth and Mr. Claude Johnson, Secretary of the Automobile Club, being chiefly responsible for the appearance of a highly creditable compilation. A second edition was called for in May, 1902, and was reprinted in December, 1902, and August, 1903. The third edition now makes its appearance, the work having been revised and improved by the addition of more up-to-date illustrations. The latest mechanical and ignition devices have received attention, the full text of the new motor law is given, and several additional chapters have been included.

Among the latter may be mentioned an instructive chapter on motor-cars for men of moderate means, in which an attempt is made to arrive at an estimate of the cost of running motor-cars of various powers. Practical personal experience is, after all, the Court of Appeal in this matter, and letters from users of light cars which have been included should be welcomed by the prospective purchasers of motors. As to the difficulty of estimating the cost of the up-keep of tyres, it is noted that the principal expense arises from the fact that manufacturers have found a difficulty in making tyres of uniform quality. One set may wear for 5,000 miles, while the next may give way in 2,000 miles. The following summary is presented, giving the estimated cost per 10,000 miles of various cars :—

	5-h.p. very light voiturette.	10-h.p. 2-cylinder light car.	15-h p. car.
	£	£	£
Tyres (pneumatic)	20·8	79·5	93·7
Petrol at 1s. 3d. per gallon	21·5	24·6	36·8
Gear body renewals ...	20·0	52·0	80.0
Lubricants, electricity for ignition batteries, &c. ...	5·0	7·0	10·0
Totals ...	67·3	162·9	220 5

Much of the information in this chapter has been derived from a paper prepared by Captain Kenneth Campbell, D.S.O., and read by him before the Automobile Club. This contained a great deal that is of special value to all users of motors, and particularly to the more inexperienced owners. The writer gave a caution against "repairer sharks," as they are called in America, recommending the motorist to deal with the builders of his car whenever possible, it being to their advantage to retain their customer's goodwill. Captain Campbell having taken the trouble to calculate as nearly as he could the saving he was able to effect by using his car instead of going by train for summer holidays, visits, shooting expeditions, etc., reckoned it at a little over £32 per annum; furthermore, he believes that he saved some £40 in cab hire and livery stable bills when in town. These figures are perhaps of no particular importance, for the reason that different people's holidays, visits, and London cabs, etc., vary so considerably, but the estimate is perhaps worth quoting. That there is a saving in doctor's bills from the benefits derived from open air excursions Captain Campbell also regards as probable.*

Two Important Marine Events.

We have received from the Technical Secretary of the Automobile Club the entry list of boats taking part in the British International Cup Race—late the Harmsworth Cup—for Motor Boats, which, by the time these lines are in the press, will have been determined at Ryde. The Cup is held at present by this country, and is competed for on practically the same lines as the Gordon-Bennett Cup for Motor Cars. The Race has been organised by the Automobile Club of Great Britain and Ireland as the trustees for the Cup, the management being in the hands of the Marine Motor Committee of the Club. Five boats were entered to represent this country, and two foreign countries challenging.

The following are details of the competitors :—

No.	Country.	Name of Competitor.	H.P.	Length.	Fuel Motive Power.
1	England	S. F. Edge, Ltd. ...	55	35 ft.	Petrol
2	,,	,, ,, ...	90	40 ft.	,,
3	,,	J. E. Hutton, Ltd. ...	150	39·95 ft.	,,
4	,,	John I. Thornycroft and Co.	120	40 ft.	,,
5	,,	Lord Howard de Walden	150	40 ft.	,,
6	France	M. A. Clement ...	180	40 ft.	,,
7	,,	M. H. Legru ...	100	39·3 ft.	Steam
8	,,	Richard Brasier ...	80	30′ 2⅜″	Petrol
9	U.S.A.	Skith and Mabley ...	150	39′ 10⅞″	,,

The Reliability Trials for Motor Boats will also have been held in Southampton Water, consisting of two runs of ten hours each day to determine the boat which can do the best performance in reliability (capability of running without a stop), speed, economy, safety, and condition (absence of wear and tear at the end of the trial). The entry list for these trials was representative of all the leading makers in the country.

Forthcoming Automobile Exhibition.

The plans of the third annual Exhibition of the Society of Motor Manufacturers and Traders, to be held at Olympia, from February 10th to 18th, 1905, have been duly approved by the London County Council. Exhibition space amounting to 100,000 square feet will be available, and of this amount 80,000 is said to have been applied for.

* "Motors and Motor-Driving," by Alfred C. Harmsworth, with contributions by the Marquis de Chasseloup-Laubat, the Hon. John Scott-Montagu, M.P., Sir David Salomons, Bart., R. J. Mecredy, the Hon. C. S. Rolls, Henry Sturmey, C. L. Freeston, J. St. Loe Strachey, the Right Hon. Sir J. H. A. Macdonald, and others. With illustrations by H. M. Brock, H. Tringham, and from photographs. Thirn Edition. Longmans, Green and Co. The Badmintod Library. 9s. net.



THE TRANSANDINE RAILWAY.

Railroads.
Highways.
Transandine Railroad.
Boundary between Chili and the Argentine.

THE CIVIL ENGINEER AT WORK.

By C. H.

Important New Works.

The past month has been marked by the opening of several important engineering schemes, and before these notes appear their Majesties the King and Queen will have inaugurated the new dock works at Swansea and the Birmingham Welsh Water Scheme. Other works which have been opened at the time of writing include the Harrow and Uxbridge Railway, the Leek and Manifold Light Railway, the new ocean pier at Dover, and the completion of the important extension works at Folkestone Harbour, carried out by the South-Eastern and Chatham Railway Company, at a cost of nearly £500,000.* The Folkestone improvement comprises the extension, widening, and strengthening of the pier, which has been provided with six new landing stages, the re-building of two railway stations, and the construction of an overhead promenade.

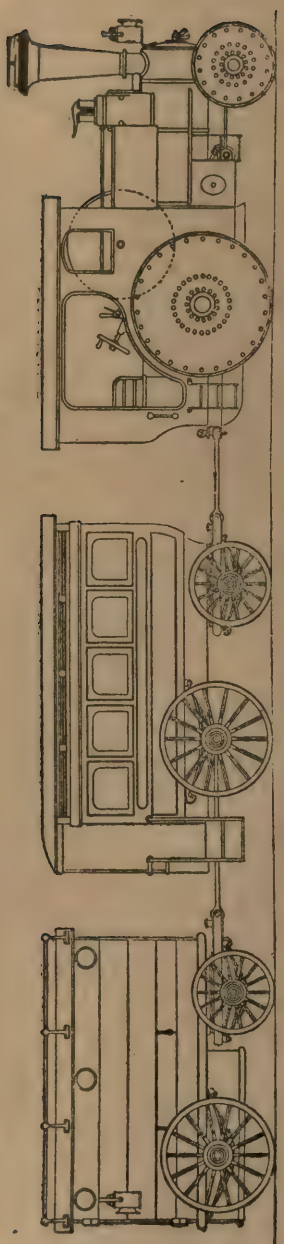
The Transandine Railway.

In a recent issue of PAGE'S MAGAZINE a brief reference was made to the proposed completion of the Transandine Railway. Among railway projects in South America this has been a leading question for half a century. Mr. Charles M. Pepper in the "Railway Age" says that though long looked upon as a dream and visionary, now it nears realisation, and there is every probability that within five years, or less, a straight-across-the-country trip can be made from the Pacific to the Atlantic, that is, from Valparaiso to Buenos Ayres. The railway progress, which is so clearly foreseen in the southern continent, in the course of years will result in building other lines through the passes of the Cordilleras, but the one in sight is that which is universally known as the Uspallata route. The reasons for the long delay have been both national and commercial, but Chili and the Argentine have now settled their long-standing differences and want to be in closer fellowship. The whole subject was revived by the passage of the guarantee law by the Chilian Congress in February last, and the succinct and decisive adoption of the means to complete the Transandine connection as government measures and as national policy. The guarantee of the State is based on the division of the work into three sections, the amount being proportional to the engineering difficulties of the respective sections.

The part of the line already built is from the town of Los Andes to Salto del Soldado (the Soldier's Leap), but in general terms the law specifies that the railway is to extend from Los Andes to the cumbre (summit) of the Cordillera, there to unite with the railroad of the same gauge from Mendoza. At Salto del Soldado the height is 1,252 metres, or 4,100 ft. At the cumbre of the Cordillera it is 3,900 metres, or 12,800 ft. The intervening grades, curves and tunnels are the problems for the engineers and contractors. The value of the first section, which extends to the crossing of the Juncal River, is estimated at 20 per cent. of the total; of the second, from Juncal to Portillo, 35 per cent.; and of the third, from Portillo to the cumbre, the section of tunnels, at 45 per cent. of the total.

In the early plans the tunnel of the cumbre was estimated at 13 kilometres (8 miles) of length, and the grade at 8 per cent., except a slight depression toward the Argentine side. The grade in the Portillo was the same except a short horizontal section. For the main tunnel, the corkscrew or spiral is favoured by engineers who have reviewed the government studies. In the first estimates, six sections of the Abt system, with a total length of 28 kilometres (17·39 miles), were projected.

* See special article, page 113, and also "P.M." Illustrated Notes.—ED.



PROPOSED ROAD LOCOMOTIVE AND TRAIN.

From these statements a fair idea may be had of the nature of the engineering work and the equipment, supplies and materials which will be required in the building and operation of the road. Everything that comes under the designation of railway material is to be admitted free of Customs duties. The source of labour supply available is native Chilian, which is very sturdy, and Italian, which has been utilised on the Argentine lines.

An expensive item in the construction is likely to be what is called "the works of defence" against the snows which choke the passes in the winter, and the wind storms which sweep with such terrific force. But, as there is so much tunnelling, snowsheds similar to those in the Sierras are not likely to be demanded extensively. However, it is specifically set out in the law that the works necessary to keep the line open through all the winter are to be constructed.

The Development of Inland Waterways.

A propos of Mr. MacDonald's article on the possible resuscitation of our canals, I note that a meeting was recently convened by the Worcester Chamber of Commerce to consider the development of inland waterways in connection with the schemes propounded by Sir John Brunner, M.P., and Mr. W. B. Needham, a member of the Chamber. Sir John Brunner's scheme provides for the nationalisation of waterways, the existing stocks or shares being converted into Consols on the basis of 25 years' purchase of the average profits for the last 25 years. The board of management would be appointed by Government, and the waterways would be free except as regards the use of wharves. Sir John urges that the public would greatly benefit if waterways were managed by a central and impartial body. Under Mr. Needham's scheme it is proposed to entrust waterways to the county councils on terms of purchase similar to those of Sir John Brunner's scheme, with representative boards of management based upon mileage. After some discussion the meeting voted in favour of nationalisation, leaving the arrangement of details to the Associated Chambers.

A Proposed Road Locomotive and Train.

In "English and American Steam Carriages and Traction Engines,"* Mr. Wm. Fletcher, M.Inst.Mech.E., gives us in readable form a freely illustrated record of ancient and modern steam carriages, road locomotives, and traction engines, representing many years of research. The author has always been a firm believer in steam as a motive power for carriages, its threatened extinction by petrol cars notwithstanding, and he states that his belief is more confirmed than ever. Among the many points of interest in this volume is a chapter in which the author gives full details of a proposed road locomotive and train for passengers and goods. A side elevation of the train proposed is reproduced herewith by the courtesy of the publishers. It will be seen, says the author, that the working parts of the engine are hidden from view; the fly-wheel is of the disc pattern, of small diameter, and every possible thought will be taken to remove any objectionable features that are liable to frighten horses. Care will be taken that the road train cannot truthfully be termed a nuisance by persons who object to the use of machinery on roads. The engine is shown drawing an omnibus mounted on springs, which will seat twenty to thirty passengers; there is shown also a light spring four-wheeled van for carrying market produce, parcels, etc., to the railway station or market town. The engine will not vary much in appearance for different districts. It is believed the character of the train will often differ; it may be altered to suit the requirements of the neighbourhood through which the train shall run. The omnibus may give place to a light-covered wagonette, so that more room and power would be available for hauling merchandise.

The author deals at some length with the restrictions imposed by legislation, remarking that our legislators and not our engineers are to blame for some of the greatest disadvantages of the present road locomotives. Engineers and owners, he says, would gladly introduce a smaller road locomotive and train if they were allowed to run them at six or eight miles an hour in the open country. Very few people know what a properly constructed road locomotive can do in the way of quick running, as such engines have been rarely tried in England. The arguments raised against the use for this purpose are based on our present engines, that are built for, and used for, a totally different service. The author's remarks in favour of quick-running traction engines are mostly based on experience. Messrs. MacLaren's parcel service in France shows what can be done. Lyons and Grenoble are nearly seventy miles apart. Each engine covered this distance in the night, and ran for hours together at eight miles an hour, over the worst possible roads and up some steep gradients.

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NAVAL NOTES.

MONTHLY NOTES ON NAVAL PROGRESS IN CONSTRUCTION AND ARMAMENT.

By N. I. D.

SINCE my last instalment of notes, there has been a very noticeable lull in the activity of the world's warship building yards. Not that work has been suspended, but the labour has been almost entirely of that nature which cannot be described more fully than by saying that there has been progress. There have been no launches of large vessels, and no completions. The majority of the battleships seem to be in that state which lies between the two stages. But to this rule there is one very notable exception. This is in the case of the *Commonwealth* battleship, building for the British Navy. The first vessel of the *King Edward VII.* class to undergo her trials, the *Commonwealth* has done very brilliantly. Laid down as late as June 17th, 1902, she was launched on May 13th, 1903, and completed her steam trials on June 25th this year, so that she should be in commission in the course of the autumn or the early winter, that is to say in thirty months. The whole of her trials were carried out in five days.

The results for the thirty hours' one-fifth power trial were: 3,644 i.h.p. developed, 70·65 revolutions, 11 knots speed and 1·74 lb. of coal consumed per unit of power per hour. The mean of six runs over the Skelmorlie measured mile at seven-tenths power was 12,769 h.p. developed, 107·45 revolutions, 17·9 knots speed and 1·68 lb. of coal consumed per unit of power per hour. The figures for the full power trial of eight hours duration, are as follows:—

No. of Run.	Time on Mile.	Speed in Knots.	Revolutions per Minute. Mean of P. and S.	I.H.P., Collective.
	min sec.			
1	3 8·4	19·1082	120·35	18,478
2	3 8·2	19·1285	119·1	17,931
3	3 12·8	18·6721	119·5	18,213
4	3 6·5	19·3029	120·15	17,947
5	3 11·1	18·8382	119·3	17,987
6	3 4·1	19·5546	119·4	18,205

The mean therefore was: speed 19·01 knots, revolutions 119·6 and i.h.p. 18,538, which is in each case in excess of the contract requirements.

It is not necessary here to repeat the principal characteristics of this vessel, which must be well known to every student of naval affairs, but her machinery, it may be mentioned, is composed of two sets of four-cylinder triple-expansion engines, supplied with steam at 270 lb. by sixteen Babcock and Wilcox boilers, having about 47,250 sq. ft. of heating surface and 1,400 sq. ft. of grate area.

The *Dominion*, a sister ship, is fast approaching the trial stage at Barrow-in-Furness.

I have, in an earlier batch of notes, made reference to the trials of the *Prince of Wales*, battleship. More detailed reports now to hand show this vessel to be far from economical in coal consumption. On her one-fifth power trial, the consumption was 2·21 lb. per unit of power per hour; on the three-fourths power trial it was 2·08 lb., and on the full power 2·02 lb. per i.h.p. per hour were consumed. The total i.h.p. developed at each trial was 3,128, 11,669, and 15,364 respectively. The *Prince of Wales's* boilers are of the Belleville type, with all the latest improvements, twenty in number.

It seems hardly likely that the suggestion put forward in some quarters that the second vessel of the new *Lord Nelson* class should be called the *William White*, will be acted upon. For while it is not to be disputed that the British Navy owes much to the ex-Director of Naval Construction, it can hardly be claimed for him that he is Nelson's equal. The *Lord Howard* would be a more suitable name, and more in keeping with the cognomen of the type ship of the class. *Ark Royal* has also been mentioned, but this name is somewhat archaic and out of keeping with modern feeling on the subject of ships' names.

Turning to armoured cruisers, the *Warrior* continues to occupy a large share of the public attention, and two remarkable statements concerning her have been made recently. The first refers to a further change believed to be imminent in the armament of this vessel. The four 9·2-in. guns which were to have been mounted in place of the ten 6-in. pieces, will not, it is stated, be placed in her, four 7·5-in. guns having been substituted for them. This report which comes from Pembroke, does not assign any reason for the change, and details of the change, beyond the statement that the guns will be mounted in barbettes at the sides on the upper deck, are lacking. The report is certainly one which requires substantiating.

The second report is even more remarkable, and far less credible. The *Warrior* has four boiler rooms, and it is proposed to provide a complete set of Belleville, Babcock and Wilcox, Yarrow and cylindrical boilers in each of these four rooms. What object it is supposed can possibly accrue from such a medley it is impossible to conjecture, and I am inclined to suspect that some perfervid imagination, in view of the dull season, has evolved this report from its inner consciousness in the hope of stimulating correspondence. The *Natal*, building at Barrow, is receiving her plates.

The scathing criticism of the "scouts" published by the *Times* has been the means of bringing to light a curious mistake in the Navy Estimates. On pp. 225 and 227 of the 1904–05 Estimates, it is stated (1) that the estimated speed of each "scout" at *load draught* on contractors' trials is 25 knots, and in an adjacent column it is stated further that the *coal capacity at* load draught of the "scouts" is 150 tons. The obvious inference from this is that the maximum coal capacity of the "scouts" is only 150 tons, whereas it is known to be in point of fact 485 tons. If, then, the official figures in the Navy Estimates are correct, with her bunkers full no one of the "scouts" can be expected to attain the required speed. Mr. Pretyman has replied to some questions in the House of Commons on this subject, and has stated that with the coal capacity of the vessels at its maximum limit, the vessel will be able to attain a speed of 24·6 knots. The object of a "scout," on Mr. Pretyman's own showing, is to be "able to approach an enemy's fleet, consisting of a number of swift cruisers, and be able to escape and give information to the admiral." But whereas Mr. Pretyman puts the speed of "swift cruisers" at 22 knots, and says "the extra three-knot speed would be useful in enabling her to escape, the *Drake* class of cruiser in our own Navy is able to steam 24 knots under pressure, and how the 0·6 knots are to assist a "scout" to escape vessels like the *Drake*, if they belonged

to an enemy's fleet, Mr. Pretyman has not explained. The *Skirmisher*, "scout," building at Barrow, is reported as nearly ready for launching.

During the month the destroyers *Ribble* and *Derwent* have been delivered at Sheerness from the contractors, Messrs. Yarrow and Messrs. Hawthorn, Leslie respectively.

The trials of the *Ribble* and *Welland*, which were run in May last, gave very good results. The full speed trial showed that the engines could develop 7,754 h.p. in the case of the *Welland* and 7,696 h.p. in the case of the *Ribble*, giving speeds of 26·02 knots and 25·82 knots respectively. The coal consumption worked out at 1·65 lb. and 1·57 lb. per unit of power per hour in each case. The boilers in these two vessels are of the Yarrow straight-tube type, four in number.

A return showing the destroyers built and launched for the British Navy since January, 1902, which has been issued, has led to some very pertinent discussions on these vessels, particularly on the question of their seaworthiness. The newer vessels, which have sacrificed 5 knots speed for additional stability, do not meet with general approbation, it being considered that vessels of 30 and 31 knots speed, if built by firms experienced in the construction of these small craft, are as safe and far more effective machines of war than the larger and less speedy vessels now being completed. The return is as follows :—

Names of Destroyers.	By whom Built.	Speed Obtained on Full-Speed Trials. Knots.	Consumption of Coal per Horse-power on the High-Speed Consumption Trials.	Average Air Pressure in the Stoke-hole on the Full-Speed Trial.
Velox (turbine) ...	Hawthorn, Leslie...	27·1	7·35 tons per hour total.	3·1
Erne	Palmer's Company	25·6	2·25	2·5
Derwent	Hawthorn, Leslie...	25·7	2·24	2·8
Foyle	Laird Brothers ...	25·6	2·79	4·4
Ettrick	Palmer's Company	25·6	2·33	2·6
Eden (turbine) ...	Hawthorn, Leslie...	26·2	7·45 tons per hour total.	5·3
Waveney	Hawthorn, Leslie...	25·6	2·19	3·2
Itchen	Laird Brothers ...	25·6	2·46	4·3
Exe	Palmer's Company	25·6	2·11	2·4
Arun	Laird Brothers ...	25·7	2·68	4·4
Cherwell	Palmer's Company	25·6	2·34	2·7
Usk	Yarrow and Co. ...	26·1	1·9	1·6
Blackwater ...	Laird Brothers ...	25·7	2·62	5·3
Dee	Palmer's Company	25·5	2·28	2·6
Teviot	Yarrow and Co. ...	25·9	2·07	2·0
Kennet	Thornycroft ...	Trials not yet carried out.		
Jed	Thornycroft ...			
Ribble	Yarrow and Co. ...	25·8	1·57	1·6
Welland	Yarrow and Co. ...	26·2	1·65	1·8

Of the Naval manœuvres I must write fully next month. The general scheme which has just been made public seems to indicate that the operations this year will be almost as interesting, although not on so extensive a scale, as those of last year.

UNITED STATES.

The new armoured cruiser *Colorado* has been running her trials, and is the first of the six new cruisers under construction to reach this stage. Her contract speed is 22 knots, and on unofficial trials she has attained a speed of 22·31 knots, but the figures of the official trials are not yet to hand. Mr. E. S. Cramp, of the famous Philadelphia shipbuilding firm, is so delighted with the vessel that he has declared her to be without a peer in any Navy. This, of course, is exaggeration. Both the *Duke of Edinburgh* and *Drake* classes in the British Navy alone must, if the vessels be compared in all their characteristics, be admitted superior to the *Colorado*, and there are vessels in other fleets at least the equals of the American cruiser.

The importance of utilising oil fuel, if it be practicable, has not been more fully realised anywhere, than in the United States, and the report of the committee of experts which recently sat to consider the advisability and possibility of the introduction of liquid fuel, makes very interesting reading. The fact that the United States has an almost inexhaustible supply of petroleum, adds to the desirability of the solution of this problem from their point of view. Six very real and very tangible advantages are shown by the Report to be likely to accrue from the use of oil fuel. Briefly they are : (1) Because of its higher calorific qualities, a less quantity—on the basis of thermal value—of oil would be required than of coal ; (2) as it can be stowed in the water-tight compartments, the space hitherto occupied by coal bunkers would be available for other purposes ; (3) the method of burning the oil fuel would admit of a considerable reduction of the stoker ratings ; (4) the advantages of simplicity and cleanliness in the replenishing of the stock of oil fuel, as compared with the dirt, dust, and practically the employment of the entire ship's company in refilling the coal bunkers ; (5) the absence of ashes and clinker, with the attendant discomfort and labour of disposing of them ; (6) the advantage—almost incalculable in time of war—in the ease with which oil fuel can be transferred from a tank-ship in tow of a warship, at good speeds, when actually engaged in war service.

But while finding the advantages attendant upon the adoption of oil fuel, the committee has not, apparently, solved many of the difficulties which stand in the way of its universal adoption.

ELECTRICAL AFFAIRS.

BY

E. KILBURN SCOTT, M.I.E.E., A.M.INST.C.E.

Cleanliness in the Manufacture of Insulated Cables.

It is within the writer's knowledge that faults which have developed in rubber covered cables, either in the factory or outside have been due to the fact that during the process of manufacture, smuts and other small particles have fallen from the roof or been blown on to the rubber whilst it was going through the machines.

Pure Para rubber is rather a sticky substance, and any matter which falls on it will easily stick and gradually become incorporated in the insulation. The importance of this fact has been recognised by some manufacturers who have made special efforts to enclose the machinery, and to so construct the roof that a minimum amount of dust would be deposited thereon. The St. Helen's Cable Company, Ltd., for example, have divided off their rubber covering machines from the general machinery, and have lined the roof of this separate shop with sheets of uralite, which has a clean smooth surface, and has the further advantage of being fireproof.

Temperature in Cable Factories.

When dealing with an electric insulation such as rubber, dialite, etc., the best results can only be obtained by keeping the rooms in which the material is handled at an equable temperature all the year round. Up-to-date factories have special plant for this object. In the hot summer days large ventilating fans being employed, whilst in winter an elaborate steam pipe system keeps the temperature above that at which the material would become brittle. Of course for part of the year, the temperature is such that neither the fans nor the steam pipe system need be used.

It is said that, as in cotton spinning, the Lancashire atmosphere is peculiarly suitable for the manufacture of cables on account of its superabundance of moisture. Whether that is so or no, there can be no doubt that the bulk of the cable manufacture of the future will be in that district.

Special Training for Central Station Engineers.

Considering that more than half the total expenditure in any given town lighting system goes in the cables, is it not extraordinary that the men in charge of same have so seldom any experience in the manufacture, or even in the laying of cables? The same remark also applies to accumulators, than which there is no apparatus which requires such expert knowledge to keep it in thorough order, yet it would be safe to say that not one man in fifty who has charge of such batteries has ever had any actual experience in the manufacture of same.

Usually it is considered sufficient if the Central Station Engineer has been trained in a dynamo or instrument making factory, with possibly some little training in boilers, engines, or other mechanical engineering work. It seems to the writer to be verydesirable that the men who have charge of such special apparatus as cables and accumulators, should have received part of their training in factories where such apparatus is made. It is the easiest thing in the world to obtain men who are conversant with boilers, engines, dynamos, switches, etc., but usually if the chief has not got the necessary knowledge appertaining to cables and accumulators, the latter are liable to be overlooked.

To show that this is the opinion of others well able to judge, the writer has in mind the career of a young engineer who received part of his training in an accumulator factory, who was recently appointed to a very important central station post.

Openings for Electrical Engineers in Collieries.

The great interest taken in the electrical exhibits at the recent colliery exhibition at the Agricultural Hall shows that colliery proprietors are at last thoroughly in earnest regarding the application of the electric power to colliery work. There is one matter on which the writer would presume to warn them, and that is the importance of their employing fully qualified electrical experts to advise on the type and magnitude of the machinery they are laying down, and also to supervise the running of same.

Where in the past the application of electric power in colliery work has not been up to expectations, it has generally been traceable to the fact that the usual officials about the colliery have interfered too much in the selection of the machinery, or it has been given into the charge of men not qualified for the work. For example, the bulk of the plant laid down in the past in this country has been continuous current, and yet it has been for some time a generally recognised fact (and the recent report of the Mines Commission confirms it) that the three-phase alternating current system is the one peculiarly adapted for colliery work. Again, when laying down an installation the matter must be attacked boldly, for it is only when all the machinery about the mine, even to the winding engine and coal cutters, are driven electrically, that the full benefits of the system are obtained.

All this points to the fact that the colliery of the future will, in addition to its usual officials, viewers, and mechanical engineers to look after the coal washing machine, etc., have an engineer who is thoroughly qualified to take charge of all the electrical plant whether on the surface or underground. The colliery viewers' training requires him to know so much of what may be termed the geological side of the business that he has not the time to do more than get a mere smattering of purely engineering matters.

POWER STATION NOTES.

By E. K. S.

Wet Steam.

It may be taken for granted that in every steam pipe range, unless the steam is superheated, there will be a stream of vapoury moisture flowing along the bottom of the piping, and tests for dryness of steam should therefore not be made in the centre of the pipe but along the bottom. This wet steam is not only a danger in the cylinders, but it also has the effect of washing all the oil out of the cylinder—a matter of considerable moment, which does not usually receive the attention it deserves.

It is clear that if this condensation water could be returned to the boiler whilst it was yet at a high temperature, there would be a considerable saving in heat units, and being absolutely pure water free from oil, etc., its concentration into one or two boilers at a time would reduce scaling.

The question is, how is such watery vapour to be returned to the boiler. Dribbling stream traps which are such a feature of English electrical stations are no solution, for they simply discharge the water into a sump, where it not only cools down, but mixes with other oily or dirty water, thus quite spoiling it for boiler feed.

The writer is of opinion that the steam loop or Holly gravity system, as much used in America, meets the case, and as its working is not generally known in this country, possibly a short description may be of interest. It may be mentioned that it is in use in the Bath Tramways Power House.

The Steam Loop or Holly Gravity System.

In the steam loop or Holly gravity system a receiver placed below the lowest point to be drained serves as a storage. From this receiver a riser pipe is taken up to another receiver placed at such a height above the boiler as will enable the water to run back into the boiler by gravity down a drop leg pipe. Given the correct proportions, the condensed water then passes up the riser pipe automatically into the upper receiver by reason of the slight condensation in the latter.

The live steam naturally tends to flow towards a reduced pressure point, and it thus carries with it any vapoury moisture and water in a similar way as an injector. If we assume a simple case of say 100 lb. pressure in the boiler, 95 lb. at the engine, and 94 lb. in the drop leg of the loop, there will then be 6 lb. difference between the pressure in the boiler and the drop leg pipe. A column of water in this drop leg standing 14 ft. above the level of the water in the boiler will thus provide sufficient hydrostatic head to balance the difference in pressure.

So long as the necessary difference in pressure at the high point of the system is maintained at a constant rate the drop leg column reaches a height corresponding to this constant difference and rises no further. The apparatus is then in full action and maintains circulation whilst there is any steam in the system.

Large Steam Pipe Bends.

Nothing more clearly shows how near we have reached the limit of steam practice than the fact that in making a bend in a very large steam pipe range it is necessary to divide up the pipe into several of smaller diameter in order to give the necessary flexibility for getting round the bend. For example, at the Manchester Station there is a double " " bend, and to get round it the main steam pipe is divided into four smaller pipes, a receiver being provided at each end. The difficulty is all the greater from the reason that with superheated steam copper bends are impossible, and it is therefore necessary to use steel.

Clearing out Steam Pipe Ranges.

When starting a new station or steam plant, it is most important that all the steam piping should be thoroughly cleaned out before it is connected up to the engines and pumps. The reason for this is, that in erecting piping there is great possibility of a piece of waste or of sand and dust, etc., being left in the pipes. If such sand is not cleared out it will be driven forward into the valves of the engines, and may do a considerable amount of damage to the internal wearing parts. Where a pipe drops down from a main steam range to an auxiliary piece of apparatus such as a pump, it is advisable to have a tee connection at the bottom instead of merely an angle. In this way, if anything gets into the pipe, one side of the tee can be removed, and it can be easily cleared out.

Filtration of Water.

The sparkling brilliancy of natural spring water is probably due to the clayey nature of the soil, alumina being one of Nature's principal filtering agents. It is interesting to note that this fact has been taken advantage of in the construction of water filters and grease extractors. It appears that aluminium sulphate has the curious property of acting as a coagulant, causing minute particles to join together and become one large particle, and it is used for this purpose in grease extractors in order to bring down the oil from the emulsified form, the condensed water being mixed with aluminium sulphate and lime. For filtering water it is also very valuable, because it becomes converted into aluminium hydrate, a gelatinous insoluble material which forms on the filter bed, and makes a very perfect filter. It is said to have the property of being able to extract colour as well as organic and mineral matter.

IRON AND STEEL NOTES.

BY

E. H. B.

The Iron and Steel Institute.

According to the provisional programme which has been arranged for the autumn meeting in the United States, it is expected that members of the Iron and Steel Institute will arrive in New York on the 21st, 22nd, and 23rd of October. The headquarters will be at the Hotel Astor at 44th Street, and Broadway. For the entertainment of the members during their three days' stay in New York, a Reception Committee has been formed including the following gentlemen :—Mr. James A. Burden, Chairman ; Mr. G. W. Maynard, Vice-Chairman ; Mr. Stephen W. Baldwin, Chairman, Finance Committee ; Mr. L. W. Francis, Chairman, Invitation Committee ; Mr. C. A. Moore, Chairman, Reception Committee ; Mr. E. E. Olcott, Chairman, Transportation Committee ; Mr. Thomas Robins, jun., Chairman, Entertainment Committee ; Mr. T. C. Martin, Chairman, Banquet Committee ; and Dr. R. Moldenke, Secretary. On Monday, October 24th, the New York Committee will arrange for optional excursions to power houses, bridges, industrial establishments, Universities, the Navy yard, subway, and other places of interest in New York, with boat trips around the harbour and drives in the parks for the ladies of the party, during the morning and afternoon, with the opening of the Annual General Meeting of the Institute in the evening, followed by a Reception. The daylight hours of Tuesday, October 25th, will be devoted to an excursion up the Hudson on a specially chartered Albany boat, stopping at West Point, where the United States Military Academy is situated.

In the morning and afternoon of the following day, there will be two meetings of the Institute for the reading and discussion of papers. In the evening the Institute will entertain the Reception Committee at dinner at the Waldorf-Astoria. For this evening a theatre party is to be arranged for the ladies accompanying members.

The party will leave New York on Thursday, October 27th, for Philadelphia, and will spend the following day there. On the Saturday morning special trains will leave for Washington, where there will be a Reception in the evening, by the President of the United States.

Tuesday, Wednesday and Thursday, November 1st, 2nd and 3rd, will be spent in Pittsburg, the main party leaving on the Friday for Cleveland.

Buffalo is to be reached on Saturday, November 5th, the party spending the night and Sunday there. Those who wish to stop at Albany to visit the General Electric Company's plant, can do so, both parties arriving in New York on the evening of Tuesday, November 8th, in time for the steamer leaving for England on Wednesday, November 9th. During the stay in Buffalo the party will be taken to Niagara and given ample opportunity to see the Falls. For the convenience of members desirous of visiting the St. Louis Exhibition, arrangements will be made for a limited number to leave Pittsburg for St. Louis and Chicago, returning to New York in time for the steamer leaving Saturday, November 12th.

Pig-iron from Briquettes at Herrang.

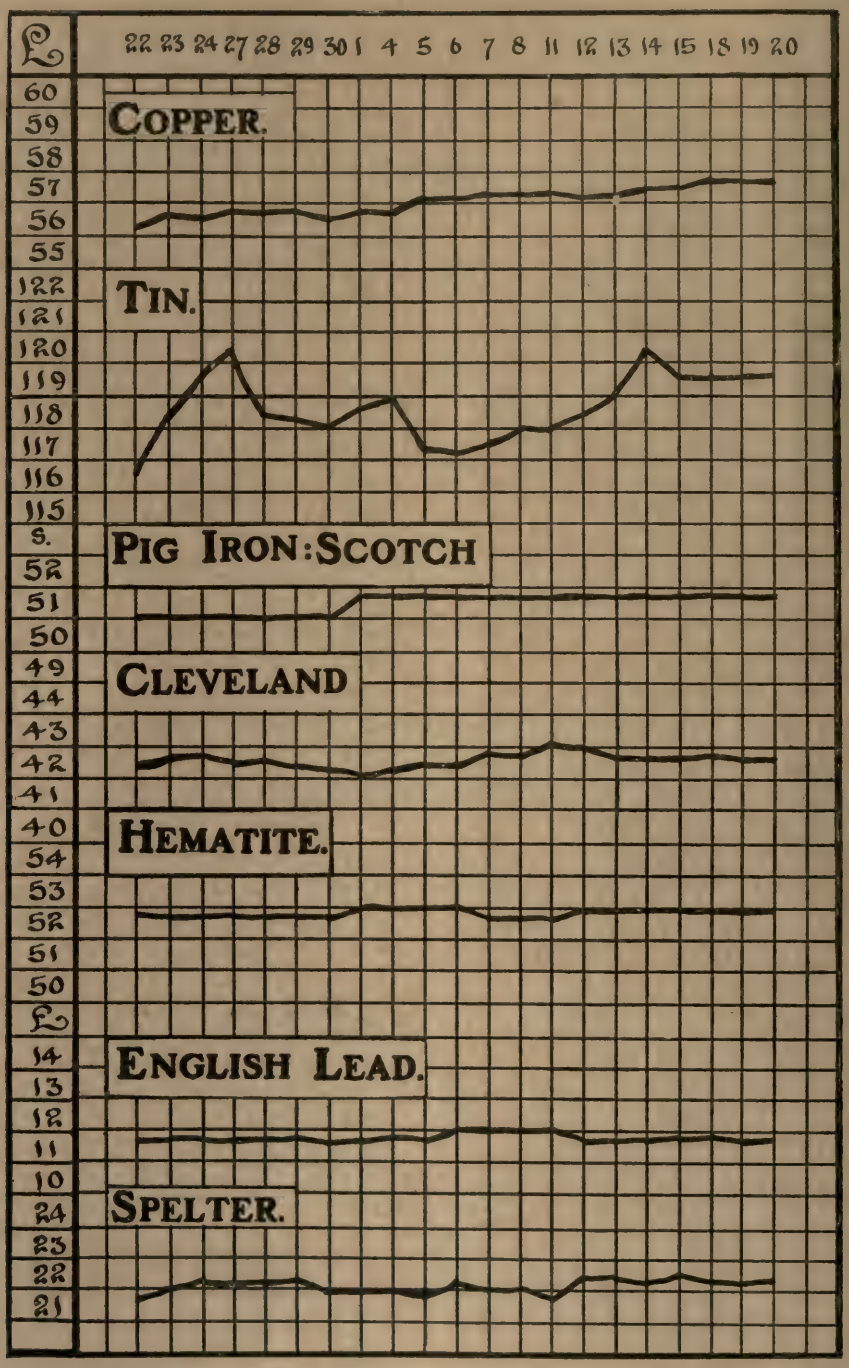
Those who had the pleasure of hearing Professor Henry Louis, on above subject, at the annual meeting of the Iron and Steel Institute, will read with interest the further particulars of this interesting development in the Swedish iron industry, appearing in "Affärsvärlden." The writer records that the production of ore at Herrang may, under present conditions, be calculated at about 50,000 tons annually. With regard to the smelting furnaces, he remarks that for the first time in Sweden, German gas engines, by means of which the gas generated at the furnaces is utilised for driving power, are at work. The power thus obtained, about 400 h.p., is used not only for the fans but also for the whole of the mining machinery and the crushing and enrichment processes.

Very effective arrangements have been made for the discharge of the coal from the vessels, transferring it to the coal-house, and distributing it to the blast-furnaces, also for transport of goods and materials all over the ground. This is chiefly done by rope runs, and the baskets travelling on these in all directions give the impression of the greatest activity.

The Direct Casting Process.

I quote the following from the Times : About 50 years ago an iron-founding works was established in the town of Wellingborough by Mr. Thomas Butlin for the purpose of utilizing the iron ores of Northamptonshire for foundry purposes. So successful was the venture that in course of time extensive works were built outside the town, and are known as the Irthlingborough Iron Works. A special product of these works is what are known as direct castings—that is, castings made direct from the blast-furnace instead of the iron being run into pigs and remelted for casting. This process was devised a few years ago by Mr. W. H. Butlin, a son of the founder of the business the growth of which has led to the erection of a new foundry. This was formally opened by Lord Lilford, a large number of visitors being present. Upon their arrival a reception was held, at which Mr. Butlin presented Lord Lilford with a silver key.

The visitors were then shown over the works, and witnessed the direct casting in operation. In this process, Northamptonshire iron ores of various grades are carefully selected, mixed, and smelted in the blast-furnace at a low temperature, a special flux being employed. The firm have four open-top blast-furnaces, two of which were in blast at the time of the visit. The molten iron is run from the furnace into large ladles, from which it is transferred into smaller ones, which are run on wagons into the foundry, where the iron is moulded into castings of various kinds, large and small. The output of iron from blast-furnaces is about 700 tons per week, about 180 tons of which is converted into castings, the remainder being placed on the market in the form of pig iron. Among other things the visitors saw the casting of segments of the lining for the Great Northern, Strand, and Piccadilly Tube Railway now in course of construction, the segments being turned out at the rate of 100 tons per week.



THE HOME METAL MARKET.

Chart showing daily fluctuations between June 22nd and July 20th.

LOCOMOTIVE ENGINEERING NOTES.

BY

CHARLES ROUS-MARTEN.

Track Troughs.

One has often felt so much wonder at the slowness with which railways came into line with respect to the adoption of the track-trough and water pick-up scoop for the use of their locomotives, that it becomes interesting, if vexatious, to find there is another side of the case. Hitherto the only "other side" that has been generally recognised is the liability of the troughs to become useless during a long-continued hard frost through the water freezing solid, and so being non-pickupable. England, especially of late years, has rarely suffered so severely from drought as for the railway track-trough to become unusable through water shortage. Yet this appears to be the case at the present time with regard to the troughs laid down by the Great Western Railway at Creech, near Taunton, in Somerset. Those troughs are supplied from a neighbouring river, and now that so many fast expresses pick up their water supply at Creech prior to beginning the steep climb up Wellington bank, the quantity of water consumed has been so large as to affect materially the volume of flow in the water. This is resented by certain millers and others who have been accustomed to use the water from the river for the purposes of their trade, and, declaring that the amount of water left in the river is insufficient for such purposes, they have sought an injunction against the use of the river by the Great Western Railway Company to fill the trough at Creech. At the time of writing, the question is still being fought out, but the Great Western authorities state very plainly that if they should be deprived of this use of the river during the prolonged dry weather, they will be compelled to stop most of their best expresses at Taunton to take in water in order that they may not encounter the disability of water shortage in climbing the long incline which extends virtually from Taunton to the summit at the western end of the Whiteball tunnel, a distance of eleven miles.

As I have pointed out before in connection with this question, the contrast of methods with which one is brought face to face as the boundary line between the London and North-Western and Caledonian Railways is crossed at Carlisle is exceedingly strong and suggestive. The London and North-Western Railway runs its West Coast express from Euston as far as Carlisle with a 25-ton tender; the Caledonian takes it northward from Carlisle with a 55-ton tender. Here we have a saving of dead-weight, which of course varies according to the amount of water and coal in the tender, but which may be as much as 30 tons in favour of the London and North-Western, a consideration not to be overlooked where such an incline as that of Beattock has to be ascended. It has long seemed not a little remarkable that these two great railways, which have from early days been so intimately associated, should yet differ so widely in this important respect. Clearly the London and North-Western finds the water-trough plan work satisfactorily, and does not experience any difficulty of sufficient gravity to militate against the advantages accruing, otherwise the practice would not be pursued of building all the tenders to work under this system. It is equally obvious that the Caledonian Railway must discern some valid objection to the adoption of a plan which would appear to make so materially for economy and convenience. So far as I am aware, the only argument publicly put forward against the adoption of pick-up-troughs has been the absence of a sufficient length of level line to render their allocation feasible. Long ago, however, I ventured to point out that this argument would no more hold water than would a trough laid on the steepest part of the Beattock incline, for on the basis of the official gradient maps I indicated several suitable points where, so far as the level was concerned, the desirable troughs could be accommodated. I did so similarly in the case of the London and South-Western, in respect of which the same adverse argument had been used. But in view of this awkward experience which now has to be faced by the Great Western, it becomes evident that other points have to be taken into account.

A Lull in Locomotive Designing.

It is not surprising that there should be at the present time a species of lull in the rush of new locomotive designs which has been experienced for some months past. Most of our British railways are now well supplied with locomotives, and also have a few of novel designs working experimentally, with a view to determine whether the permanent extensive adoption of such new designs would be desirable. The Great Western is steadily testing its "Albion," "La France," "Cities," "Counties" heavy tanks, "Consolidation" goods, and other types; the London and South-Western has its new express class with the standard 6 ft. 7 in. driving wheels, larger boiler and cylinders. The Great Northern, after a lengthened trial of No. 251, the "Atlantic," similar to Nos. 990, but with enormously bigger boiler, having 2,500 sq. ft. of heating surface, is turning out a large batch similar to No. 251. I may remark in passing that in my own experiments with No. 251 I found her do most excellent work alike in speed and in haulage, yet practically not superior to that which I recorded with the smaller-boilered "Atlantics" on the same line, notably Nos. 990 and 253. This did not surprise me, nor did it seem to afford the slightest warrant for doubting the advantage of the larger boiler, for while Nos. 990 and 253 may have done as well as No. 251 with the train each hauled, weighing about 250 tons behind the tender—to haul which at high booked speed was quite within the compass of the smaller boilers—I entertain no doubt that had another 100 tons been added to that load, No. 251 would have done equally well, while the

smaller-boilered engines would have been overtaxed. It must never be overlooked that it is the combination of great weight with great speed that so severely tries our modern locomotives. I instanced last month a case showing how this operated with one of the very fine new London and North-Western engines designed and built by Mr. Whale. That engine was able not only to keep, but to improve on, the fast booked timing, with 360 tons behind the tender, but could not maintain time when given the enormous weight of 420 tons and required to pull it at an average start-to-stop rate of over 54 miles an hour. So I anticipate that the new big-boilered "Atlantics" on the Great Northern will be found invaluable in working the excessively heavy East Coast Anglo-Scottish traffic that has to be dealt with during the month of August. The London and North-Western and Midland have still under trial the Whale "Precursors" and the Smith-Johnson compounds respectively. Indeed, both types seem to me to have already passed beyond the experimental stage. In my opinion both have effectively established themselves as highly valuable and efficient machines, and I anticipate seeing them multiplied. Also on the Midland the Belpaire class of non-compounds, of which no fewer than fifty engines are now running, have indisputably established themselves as a complete success. Most of the other British railways seem to be pursuing a normal course. On the Caledonian, Mr. J. F. M'Intosh has just turned out a new batch of express engines, but in these he has practically reverted to his very admirable "900" or enlarged "Dunalastair" type, from which the newcomers differ only in minor details. They have 6 ft. 6 in. driving-wheels four-coupled, inside cylinders 19 in. by 26 in., 1,615 sq. ft. of heating surface, and 180 lb. steam pressure.

The Summer Train Services.

A very remarkable development in British railway speed has taken place this summer, which has brought us two daily runs of 246 miles without stop, booked at an average of 55·6 miles an hour, an acceleration of the previous "longest-non-stop-run-in-the-world," 193¾ miles, to an average of 56·7 miles an hour, all of these being to the credit of the Great Western. Also splendid accelerations of the London-Manchester train services, to 3 hrs. 30 min. each way by the London and North-Western, 3 hrs. 35 min. by the longer and steeper Midland, and 3 hrs. 50 min. by the much longer and also difficult Great Central. When it is recollected that little more than two years ago the time of 4 hrs. 15 min. from London to Manchester was generally looked upon as the irreducible minimum, the leap forward that has been taken may well be regarded as epoch-making. In point of absolute maximum booked speed, there has been no advance; the blue ribbon in this particular still rests with the North-Eastern Railway, which has a single run booked at 61·7 miles an hour average speed from start to stop. It is curious also that the Northern Railway of France, which leads the whole world as regards its number of fairly long runs booked at averages of 60 miles an hour and upward, and which has multiplied that list this year, does not revive its wonderful booking of 63·5 miles an hour which existed three years ago, and which was even improved upon in actual work, and does not equal our English maximum by about one mile an hour, although Britain can boast nothing like the six expresses which average over 60 miles an hour from start to stop for distances ranging between 79 and 112½ miles in length. When bookings of such speed as the English and French of the present summer are casually mentioned, it is no uncommon thing for the question to be raised whether these paper promises are really fulfilled in practice. On this head I could say a good deal. Those of the French Northern Railway, as I have already observed, are not only fulfilled, but almost invariably even bettered. I am glad to be able to add the same with regard to our not-quite-so-fast British bookings. During the past month I found the Great Western non-stopping train from London to Plymouth accomplish its run with the utmost ease in 1 min. to 6 min. under time, easing down all the inclines. The case was similar as regarded the accelerated London. Manchester trains on the London and North-Western.

I felt warranted in anticipating this result in both of these cases, but I confess to having felt a certain degree of doubt as regarded the Midland and Great Central accelerations in view of the serious difficulties with which the trains of those lines had to contend. A very agreeable "disappointment" awaited me. The Midland express, timed to cover the 190 miles between St. Pancras and Manchester in 3 hrs. 35 min., which many experienced railway men roundly declared to be impossible, accomplished the feat with almost ridiculous ease. Notwithstanding a vexatious signal stop 22 miles out of London, Bedford (49¾ miles) was reached in 49½ min., and Leicester (99 miles) in 99 min. 9 sec., while the continuation to Manchester over the severe grades and sharp curves of the Derbyshire Peak district was readily performed in less than booked time, although very moderate speeds were run down the steeper grades. The experience was very similar with the up journey, and as a matter of course the actual travelling time each way, without making any allowance for signal or other delays *en route*, was almost exactly 3 hrs. 20 min. The engine in each case was a non-compound Belpaire, and the load approximately 170 tons behind the tender. In the case of the Great Central's 3 hrs. 50 min. express from Marylebone to Manchester the results were little less astonishing. The booking of this train from London to Sheffield, 163¾ miles in 2 hrs. 57 min., was looked upon as bold even to recklessness; but we did it, virtually without effort, in 9 min. less than even this fast booked time, getting to Sheffield in 2 hrs. 48 min., and then, after waiting out our time at Sheffield, reaching Manchester three minutes early. At this point space limit compels me to stop, but I shall yet have a good deal to say regarding the brilliant achievements of our British railways during the current summer.

OPENINGS FOR TRADE ABROAD.

British India.

The Government of Madras has applied, or are about to apply, to the Mysore Durbar for the loan of the services of Major Joly De Lotbiniere, R.E., for a few months in connection with the utilisation of Periyar power for industrial purposes. The idea mainly is to examine the possibility of conducting electrical power from the Periyar dam to Madras city for lighting purposes, the distance being over 300 miles; there are 126 miles of road in Madras to be lighted.

There will shortly be a great demand for electric ventilators and other electrical apparatus for Bombay. At the present time hardly any of these articles are stocked in the city, as generating stations are few and far between. A station is, however, being erected by the Municipality of Bombay for the distribution of electric light and power, and a good opening for electrical apparatus will thus be created.

Switzerland.

Plants for electric lighting and supplying power, are to be erected in the towns of Zweisimmen (Canton of Berne) and Murg (Canton of St. Gall).

Italy.

There is a good opening for Motor-Cars.

Russia.

There is already a considerable field for all electrical appliances in Russia, and in the future this will probably become far greater.

In the various cities the tramway systems are being converted—or have already been converted—to electric traction, electric lighting is being installed, etc.

The Moscow authorities commenced the conversion of the tramway system last year, and a considerable amount of work in this direction has already been accomplished. The whole undertaking will not take less than five years to complete, as the long winter season naturally considerably curtails the number of working months.

Egypt.

The Mahmoudia lock gates in Alexandria are to be re-modelled; the work will include the supply and erection of two pairs of wrought iron lock gates. Tenders will be received up to August 5th.

South Africa.

The Municipality of Kalk Bay has been empowered to contract a loan for the purpose of supplying the town with electricity.

Cape Colony.

We learn that of the recently floated loan raised by the Municipality of Port Elizabeth, the sum of £100,000 is to be used for the installation of electric lighting. The agents of the Municipality in London are Messrs. Davis and Soper, 54, St. Mary Axe, E.C., from whom all particulars may be obtained.

Mexico.

A concession has been granted to the Compañia del Sur Pacífico for the construction and working for a period of ninety-nine years of a normal gauge railway in the territory of Lower California between two points on the frontier of the United States with the faculty of extending the line to the Bay of Todos Santos.

Peru.

The construction of the following railways has been authorised :—

(*a*) From Oroya to Jauja and Huancayo.

(*b*) From Sicuani to El Cuzco.

(*c*) From a point on the line between Oryoa and Cerro de Pasco to a point of the river Ucayali or one of its tributaries, which can be approached by steamers all the year round.

It is left to the discretion of the Government whether the construction and working of these lines is to be conceded to a private enterprise or to be undertaken by the Government; the Government may also promote the formation of a Company for their working. The following sums are allotted for the railway works referred to, viz. : in 1904, £100,000, in 1905, £150,000, in 1906 and subsequent years, £200,000. Surveys of the following proposed lines are also to be undertaken, viz. :—

(*a*) From Huancayo to El Cuzco.

(*b*) From a point on the coast between Salaverry and Paita to a point on the river Marañón or one of its tributaries, which is open to steam navigation all the year.

(*c*) From a point on the Juliaca railway to a point on one of the rivers in the south of Peru, accessible to navigation.

The Government is further authorised to contract for the construction of a railway from Puerto de Paita to the river Marañón.

Argentina.

In connection with the extension of the Central Northern Railway to the Bolivian frontier, a Presidential decree has been issued approving Messrs. Luis Stremiz y Cia's contract for the construction of works, etc., at Tafi Vieja at an estimated cost of about £195,000.

Ceylon.

The Government is seriously considering a proposition to substitute light running motor-cars on all roads able to bear the strain, in the place of the old coach which is still in existence on some important roads for the carriage of mails and passengers. The speed stipulated is 30 miles an hour, and each car is to carry six passengers and 3 cwt. of mails, besides ½ cwt. of baggage.

AMERICAN RÉSUMÉ.

BY OUR NEW YORK CORRESPONDENT.

NEW YORK, July 19th, 1904.

Postal Reforms wanted.

The Postal Progress League is doing what it can to bring about an improved state of things in the American foreign postal service. Under existing regulations an American has to pay five times as much to send a 2-oz. letter to London as to Shanghai. The tax levied on the American publisher of magazines and periodicals forwarded to Europe is eight times as much as the same packages would cost him if addressed to Shanghai, Hawaii or Manila.

Railway Building.

Compared with the corresponding periods of 1902 and 1903, the first six months of 1904 show a falling off in the amount of new railways constructed in the United States. The track laid amounted to only 1,937 miles. This is explained by increased operating expenses and decreased traffic, resulting in smaller net earnings, together with a continued stringency in the money market.

The use of Steel in Passenger Car Construction.

This was the subject of an instructive paper presented at the Master Car Builders' Convention by Mr. William Forsyth. The writer pointed out that the competition between the different lines has advertised itself by offering to the public luxurious trains of buffet, dining, parlour and sleeping cars, which are built by the contracting car companies. Each successive train has added greater weight to the fast express trains until the locomotives are scarcely equal to the task of delivering them at terminals on schedule time. The parlour and sleeping cars now employed are considered satisfactory in regard to strength in resisting wrecks and collisions, but they are not fireproof and their strength is obtained at the expense of great weight. They are thus a menace to the weaker cars, coaches, chair cars, baggage and mail cars in the front of the train.

Mr. Forsyth describes a complete plan for a coach of modern dimensions with steel underframe, much of the body being also of steel. The whole side of the car is a compound steel girder made up of the deep plate girder below the windows, with numerous posts riveted to it, and a stiff side plate connecting them at the top, the whole construction being tightly bound together. It is probable that the first cost and the weight of a car of this design will be somewhat greater than the regular wooden coach, but from the experience gained in building such cars it is believed that with a steel car of somewhat similar construction, having the advantage of pressed steel forms wherever possible, and such improvements as are always developed in actual construction, a cheaper and lighter car can be built by the use of steel, which will be stronger in resisting the force of collision and practically fireproof. The steel passenger car will thus be developed by experience in construction, by a display of ingenuity in designing efficient details, and the adaptation of fireproof materials to a simpler inside finish.

Steel Underframes in England.

It should be understood that all the large timbers are removed and the floor can be made entirely fireproof. The quantity of wood in the car body is very much reduced and the small sections could easily be made fireproof. It is desirable to have wood or an equivalent non-conductor on the inside of a steel car of this or almost any other construction, not only for inside finish but as a non-conductor in order to make the interior comfortable in hot or cold weather and to prevent noise. Steel underframes for sleeping and dining cars, 65½ ft. long, have been built in England, and by way of illustration, the author describes one of those built by the London and North-Western Railway for the fast trains on the East Coast route between London and Edinburgh. In these cars the centre sills are of 9¼ in. by ⅜ in. channels, and the side sills 10 in. by ⅝ in. channels. There are four truss rods, the outside one being 1½ in. in diameter, and the centre ones are 1¼ in. in diameter. They are braced diagonally and the drawbars are continuous. In order to prevent noise and to make the car less rigid, the sills are covered with a thin strip of pine, and on this a continuous line of rubber, and the car body is bolted to the sills. The car body weighs 58,000 lb., two trucks 32,000 lb., total 90,000 lb A model of this car is now on exhibition at the St. Louis Fair.

Other Examples.

The majority of the large cars for long distance electric lines are now built with steel underframes. The new cars for the Rapid Transit Company of New York are built almost entirely of steel. These cars are 51 ft. 2 in. over platform sills, and they are 8 ft. 7 in. wide over sheathing. The cars have a capacity for 54 passengers. The Illinois Central Railroad has designed and built at its own shops quite a number of large steel suburban cars, having 100 seats. These cars are 64 ft. long over end sills and 10 ft. 4 in. wide. The underframe consists of four 9 in. 21 lb. steel I beams, spaced nearly equal distances apart. The end sills are 9 in. 25 lb. steel channels, set with the backs to the square ends of the longitudinal sills, and riveted to them by double angle plates reinforced by plate gussets. A steel floor ¼ in. thick is riveted to the sills, forming a continuous metal surface, extending the whole width and length of the car, thus insuring perfect rigidity of the underframe and completely protecting the car from fire underneath. The side posts are made of 3 in. 4 lb. steel channels, and the side plate is 4½ in. by ½ in. iron. The car body weighs 61,400 lb., trucks 23,000 lb., total 84,600 lb. These steel cars have been in service more than a year, and one of them is on exhibition at the St. Louis Fair.

The State of American Shipping.

The Merchant Marine Commission appointed by Congress to inquire into the state of American shipping has discovered, according to Senator Gallinger, three reasons why the American ship cannot successfully compete in the foreign trade. The first is

the added cost of construction, the second the higher cost of operation, and the third that other nations have subsidised their shipping. Some of the evidence collected by the Commission during its progress from place to place makes interesting reading. So diverse are the opinions, however, that one looks upon the Committee as a species of gigantic snowball gathering difficulties as it goes. On one point there is general agreement, viz., that something must be done. Take, for instance, the evidence of Mr. H. Coulby, President and General Manager of the Pittsburg Steamship Company. One could scarcely be more emphatic. "Everyone was agreed," he said, "that the merchant marine was very sick. They had all looked at him in his little bed and had all concluded that he was very sick. He did not know that he had seen many prescriptions to remedy his condition. What they should be after was the enlargement of their markets; but before they could sell their products abroad, they had to get the stuff there. Eight years ago," he said, "he was coming home from England, and on the steamship met two travelling men who were agents for steam shovel and mining machinery manufacturers. They were very much discouraged. They had been attempting to introduce these products in South America and South Africa, and had run up against the question of transportation, and the fact that the business had to be transacted through London. The circuitous system and the necessity of exchange robbed the business of all profit."

Continuing, he remarked that "transportation between consumer and producer was a science. Railroad men agreed that it must be carried on in a straight line. The moment one stopped a ton of freight, one added to its cost. The cost might be imperceptible, but it was nevertheless accumulating. What was wanted was an absolutely straight connection with the foreign market. This question was a transportation question pure and simple. If under their system of life it cost more to operate an American ship on the high seas, let the American people put up the difference."

"The American sailor would not work for Swedish wages. Then let them put a strip on his hat reading 'United States naval reserve,' and pay him the difference. They would then have a claim on his services in case of war. Other countries did it, and they were not to be blamed if they fought them with their own weapons. If they could assist in establishing a few lines to strategetic points in various parts of the world, American business methods would solve this question much sooner than they would expect. And, gentlemen," he concluded, "you will have to do it. If you don't do it now, you will have to do it later. It's the nation's life. If you don't do it you will find that our commerce will simply back water on us, and that eventually you will be compelled to do it."

The Allis-Chalmers Company.

Mr. A. M. Mattice, Chief Engineer of the Allis-Chalmers Co., has returned from his European tour of inspection, and has now settled down to the duties of his position in Milwaukee.

While in Europe Mr. Mattice visited the Hydraulic Machinery Works of Escher Wyss and Co., of Zurich, and arranged important details concerning the manufacture in the United States of their lines of product. He also inspected the Nurnberg Gas Engine Works, at Nurnberg, and at the well-known engineering establishment of Willans and Robinson, at Rugby, England, he paid particular attention to the products and methods of manufacture of the Steam Turbine Advisory Syndicate, of which important organization Allis-Chalmers Co. is the American member. Mr. Mattice had several important consultations in London with Mr. Yarrow, on the subject of turbines for marine purposes, and while on the Continent he made, in the Allis-Chalmers interests, a series of exhaustive tests of the Zoelly steam turbine, of which so much has recently been heard,

The results of Mr. Mattice's European visit of inspection will be awaited with a good deal of interest by American engineers.

How Cables are Cut.

In the course of a paper on "Cable Cutting," contributed to the United States Naval Institute, Capt. Goodrich, of the United States Navy, described the appliances needed by a ship assigned for this sinister purpose in times of war. They are few in number and simple in nature, consisting of a suitable instrument for grappling the cable, a stout flexible line attached to the foregoing and a steam windlass capstan for heaving in.

The grappling instrument, known as a centipede, is based upon the idea of a heavy bar of iron or steel about 4 ft. long, provided with numerous short hooks distributed along its four sides. Its shortness and weight enable it to search out the interstices between boulders, and thus seize the cable in its hidden lair.

In a centipede ordered for the *St. Louis*, but never used on account of the speedy collapse of the Spanish resistance, a 5-in. iron pipe was substituted for the bar. Holes were drilled through it from side to side, square bars of $\frac{3}{4}$-in. steel about 15 in. long were forced through these holes, the ends bent in the same directions, and the metal upset to hold the claws firmly in place.

The grapnel creeps over the bottom, its prongs burrowing slightly under the surface of the soil until they catch underneath the cable. The gradually increasing tension on the grappling rope reveals to the expert, whose hand is always on the outboard part, that the cable is caught. . . . It is well to keep going ahead for a few minutes after getting an unmistakable bite, in order to lift the cable off the bottom, and thus ensure its being hooked. Then the ship is stopped and the line, taken to a steam winch or capstan, is hove in. As soon as the bight is well out of water, a hawser is bent to it and the grapnel relieved of its duty. When the cable is inboard, a stout plank to protect the deck, a couple of sharp blows with an axe and the thing is done. Letting go one end and steaming a couple of miles away with the other will make a gap of sufficient magnitude to embarrass the repair steamer, should she come along before peace is declared.

SOUTH AFRICAN RÉSUMÉ.

BY OUR JOHANNESBURG CORRESPONDENT.

Imports into the Transvaal.

I quote the following interesting figures on the authority of the "South African Mines' Commerce and Industries." The imports into the Transvaal in 1903 were obtained from the countries mentioned below :—

	1902.	1903.
United Kingdom ..	£5,840,681	£8,631,794
British Possessions ..	251,209	801,866
Foreign Countries ..	1,403,070	3,633,873
Local Purchases ..	4,781,990	5,012,892
S.A. Produce ..	755,383	1,244,892
O.R.C.	35,238	126,101
	£13,067,671	£19,451,048

The value of goods consumed on mines, chemical and metallurgical works last year was as follows : Gold mines, £5,515,675 ; coal, £306,239 ; diamonds, £76,011 ; works, £50,733 ; total, £5,948,658. The gold mines consumed nearly 5,500,000 lb. of cyanide (value £229,000), 1,151,793 tons of coal (£873,231), 216,458 cases of explosives (£732,000), £725,000 worth of machinery, £418,814 worth of food, and £468,596 worth of timber.

The Mechanical Engineers' Association of the Witwatersrand.

The Council's report presented at the annual meeting of the above society, pointed out that the advance in membership had not been rapid, because of the qualifications required for full membership. Unless an applicant could fully comply with the requirements he was not admitted. This had had the effect of raising the standard of the Association. During the past session no difficulty had been experienced in securing papers. The Association's journal had been brought to a high state of efficiency, mainly through the efforts of its editor, Mr. A. C. Whittome. The question of extending encouragement to inventors was still under consideration. The financial statement showed that the receipts aggregated £1,717 17s. 8d. and the expenditure £1,282 19s. 1d., leaving a credit balance of £434 18s. 7d.

Engineering Economies.

When the Mechanical Engineers' Association of the Witwatersand, visited the Pretoria Railway workshops, members were freely invited to ask for the explanation of any points of interest. This invitation was taken seriously and a number of questions were duly submitted. They have since been published, together with replies by Mr. Hyde. Among others were the following :—

Question.—Have the American type of bar frames been found to be more suitable for the severe conditions of African railroads than the English type of plate frames ?

Answer.—We have 100 engines of the bar frame type ; they are more trouble than the plate frames, and we have a number broken. Our latest types of engines have all been designed with plate frames, and I do not think we shall repeat the bar frame design. There is no difference in cost, and though, perhaps, our frames suffer from poor design, owing to insufficient experience of the bar frame, our experience of plate frames is so large and so satisfactory that I think we are right in reverting to plate.

Question.—The essential features of a central electric power station is towards economy. Why are discarded loco. boilers used, and why are they not all lagged ?

Answer.—Our boiler plant was intended after having been worked to supply steam, to be a sample of what a boiler plant should not be. We have always regarded it as purely of a temporary nature in view of the fact that a brand new water-tube plant, with every form of economiser that even a boiler expert could suggest, was being put in. We expect our Babcock and Wilcox boilers will save 30 per cent. One of your members, whose pumps we are getting, says they save 7½ per cent. of coal ; our Yankee forced draught is to save 20 per cent. My own patent economisers and feed heaters will certainly save not less than 40 per cent. ; and our only trouble now is that we have a chain grate stoker to put in, which I am credibly informed will save 15 per cent., and I do not know what is to be done with the odd 12½ per cent. ; at present we contemplate reversing the action of the grate, and loading 12½ per cent. into trucks for sale to the mines.

South African and Australian Railways compared.

In the course of his Presidential address before the Association of Chambers of Commerce of South Africa, Mr. Jagger made an interesting comparison between South African and Australian railways. He remarked that notwithstanding the fact that the mileage and capital of the South African railways are only a little over a third of those of the Australian, the gross earnings for the Cape, Natal, and C.S.A.R. were last year £13,272,179, and for the whole of the railways in the Australian Commonwealth £10,549,289. As far as he could judge from the figures, four factors had contributed to the much larger earnings of the South African railways. The first was that a greater proportion of the traffic was in the carriage of imported goods inland, and these usually paid a higher rate than Colonial produce. Secondly, they evidently got very much more work out of their lines. Thirdly, the long haul of a large portion of the goods from the ports inland, especially on the Cape lines ; and, finally, on the Natal and C.S.A.R. lines, the higher rate of carriage charged, the average earnings per train mile on all Cape lines being 8s. 4½d., on the Natal 10s. 6½d., and on the C.S.A.R. 13s. 4d., as compared with about 8s.—the average earnings per train mile on the Australian railways. But if the earnings of the South African lines were high, the working expenses were also much heavier than on the Australian railways, the total working expenses of the three systems, being last year, £9,291,437, as compared with £7,207,444, the cost of working all the Australian systems, and in ratio of expenses to earnings the Cape was higher than any railway system either in South Africa or Australia, the percentage being 84.9 per cent. as compared with Natal's 69·9 per cent., the C.S.A.R. 55·3 per cent., and Australia's 63·9 per cent. Of course, it was only fair to say that on the Cape lines a good deal of betterment was charged to working expenses which on other lines is charged to capital account.

GERMAN RÉSUMÉ.

Superheated Steam for Locomotives.

A consular report calls attention to the investigation and experiments that have been carried on in Germany with super-heated steam locomotives. They have established the fact that superheated steam can be used efficiently with locomotives as well as with stationary steam engines. When the greatly superior efficiency of superheated over saturated steam is taken into consideration there seems strong reason to believe that the great success already obtained by the stationary engine will be repeated with the locomotive—that materially superior economy in power will be attained by the use of superheated steam, which will in time come into general use for locomotives.

German Technical Colleges.

The technical colleges of Germany, according to the latest reports, are attended by 12,384 Germans and 2,242 foreigners, some 43 per cent. of the latter number being Russians. The total percentage of foreign students is 15. Some of the German papers are protesting against the admission of foreigners to German technical schools, alleging that it will injure the manufacturing and export trade of the German Empire. Fear of competition from the United States appears to be the especial cause of this agitation.

Cylindrical Movable Dams at Schweinfurt.

We are indebted to the "Scientific American" for the following interesting details of the two dams which have been erected under special conditions at Schweinfurt. This city, on the river Main, can boast of a type of dam which presents features of construction and operation which are undoubtedly novel. Two dams have been constructed, both cylindrical in form and arranged to be lifted bodily above the water. They were built partly to render the stream above them navigable and partly to divert the water for power utilisation. As the river is one subject to heavy floods, a type of dam that would permit a very rapid discharge of the freshet water had to be designed, and the cylindrical form, arranged to roll upward above the flood level, was adopted. To demonstrate fully its practicability, the first dam was constructed across a secondary branch of the river at Schweinfurt, with a total length of 59 ft. and a diameter of 13·58 ft. The satisfactory operation of this led to the construction, across the main branch, of a larger dam, 115 ft. long and 6·56 ft. in diameter. Briefly, it is a hollow cylinder of sheet steel, on each end of which is fixed a toothed wheel which meshes with an inclined rack built in each abutment.

The dam as a whole consists first of a sill upon which the cylinder in its lowermost position rests. This cylinder is 6·56 feet in diameter and extends from shore to shore, a distance of about 35 meters (116 ft.). When lowered, this enormous cylinder effects a rise in the river of 6½ ft.

Special Conditions.

Among the conditions first established, and under which the dam was to be constructed, it was stipulated that there were to be erected in the stream no piers or other supports that might interfere with the free movement of the ice in the spring. Not even temporary supports that could be removed upon the general breaking up of the ice or even at the close of navigation, were allowed, simply because in order to insure their stability, foundations, or the like, would have been necessary to sustain them, and these would become permanent obstructions likely to be damaged by freshets.

Method of Raising the Cylinders.

The first dam designed differed materially from the second in the method of raising the cylinder. It was designed to be hauled upward from its lowest position by cables on each end. In the second, later dam, the driving mechanism is all located at one end. When the downstream level of the water rises, the pressure has a tendency to lift the gate. The cylinder itself is watertight, to prevent the freezing of the water which might otherwise collect in it. Still an interior pipe is provided in the smaller dam open at each end of the dam, but shielded by its interior location from the cold. This pipe is filled with water to secure greater stability. The racks in the case of the second larger dam are placed at an angle of 45 deg. The cylinder, in its lowest position, rests on a sill of oak and the tightness of the dam at each end is provided for by a band of leather around the periphery. The pressure of the water holds the leather against the sill. The weight of the movable cylinder of the first dam is 158,400 pounds. To bring it above the level of the highest flood it is necessary to raise it a distance of 16·4 ft. It is arranged for hand working, with six men on each side. Assuming that each man can perform work equivalent to 57·75 foot-pounds per second (8 kilogrammeters), and allowing for an efficiency of 35 per cent. in the hoisting mechanism, the time required to lift the cylinder the given distance is determined as follows, remembering that twelve men are engaged all told: 158,400 by 16·4 ÷ (57·75 by 12 by 0.35)=10,710 (seconds), or 3 hours. To lift the cylinder above ordinary freshets, only about half this time is consumed.

The larger dam was begun in May, 1903, and was put in service in December. Its rollway length is 114·8 ft., but its actual length is 121·3 ft. 3·28 ft. of each end extending into the masonry of the abutment. The steel is 1¼ in. thick, built in sections 9·84 ft. long, with a single longitudinal joint. The transverse joints are butt joints, each section being reinforced in the middle by a brace contributing to its rigidity. This cylinder is watertight except in two chambers in the upper part at each extremity. When the downstream water level does not rise more than 3 ft. or so above the bottom of the dam the weight of the cylinder is sufficient to counterbalance the pressure; but when the water level rises above this limit, the water enters the two chambers, giving the cylinder added stability. The racks in the case of this dam are inclined at an angle of 45 degrees only along the upper part. Toward the bottom, the pitch is increased, attaining 4 to 1. This increase in pitch is made on a radius of 10·46 ft. The steepness of the bottom part of these racks gives the dam better bearing against water pressure tending to raise it. The weight of the cylinder is 193,600 pounds.

The operating apparatus includes two steel cables of 1·8 in. diameter, each formed of six strands. The two cables are rolled on drums, and to raise the cylinder above high water, that is to say, 13·12 ft., an electric motor of 18 h.p. is employed, and the operation takes less than a quarter of an hour. The mechanism is also provided with four cranks, by means of which the dam can be lifted by hand. The cranks drive a worm gearing through chains, and this, in turn, meshes with a train of gears and a chain to the hoisting drums.

AUSTRALIAN NOTES.

By a Special Correspondent.

MELBOURNE, June 16th, 1904.

The Trade Outlook.

The outlook from the point of view of the British engineering trade and its allies cannot be described as very hopeful. Politics react upon business in this new Commonwealth with striking celerity. Stable politics means an expansion of enterprise and a stream of orders to the British electrical and engineering firms ; uncertainty means stagnation and nervousness. The policy of tightening the control of the State and the Federation over the rewards and hours of men of industry, as exhibited in Arbitration laws and drastic Factories Acts, renders the heads of Australian commerce extremely cautious in the undertaking of new experiments which require the importation of elaborate machinery and the organisation of new factories. With a Labour Government in command—albeit temporarily—of the Federation, and a growing Labour party in each of the six States, the captains of industry in our midst hesitate, defer, and finally lock up their profits in "safe" securities. In short, so far as private enterprise is concerned, the British ship-builder, engineer, and manufacturer must not look for an increasing volume of business in Australia. Stagnation is aided by the cry of "Australian industry for Australian workmen," with the result that, even in private businesses, the tendency is to import nothing but plant and essential parts, and to manufacture as much as possible locally. Should the movement in the direction of subsidising an iron industry to work the iron ore deposits in Tasmania and New South Wales be successful this tendency will become more pronounced. Australians will manufacture their own steel rails instead of importing them, and will, through one or two big foundries turn out everything in the way of rough castings their less than 4,000,000 of population need.

Big Schemes Ahead.

If, however, the outlook is gloomy as regards private enterprise, there is something to set to the *per contra* account when the field of governmental and municipal activity is touched. Notwithstanding the tremendous indebtedness of Australia's State Governments and the strong anti-Socialistic wave of political feeling now beginning to travel over the entire continent, it is inevitable that enormous purchases in machinery of all descriptions will have to be made by our paternal socialistic governments, in America and Great Britain in the very near future. For example, the state as the owner of our railways is now being gradually forced by public opinion to electrify the lines in the suburbs of the principal capitals and to regulate the export of all produce. That means more and more business for the British exporter of electric motors, freezing plant, modern cars, etc. The State, too—especially in Victoria and New South Wales—is being compelled to link a costly irrigation policy with the "back to the land" and "closer settlement" cries of the politician. Governments are committed to elaborate irrigation schemes which will divert the waters of the Nile of Australia—the river Murray—on to the dry lands that fringe the borders of New South Wales and Victoria. Some of these must be begun within the next three years, with the resultant flow of orders to the United States and England for special locking machinery and irrigation plant. Then there is the great project to which the Commonwealth Government is being slowly but surely committed—the Great Trans-continental Railway, which is to connect South with West Australia at a cost of nearly £5,000,000. As I write, the scheme is being fought on the score of its extravagance and probable unprofitableness to Victorian interests ; but the feeling of the National Parliament is strongly in its favour, and before long £20,000 will be voted for a contractor's survey. The railway may take years to "arrive," but "arrive" it will, as the price of West Australian property owners' loyalty to the Federation. It will be built out of the taxpayers' money, and should yield a harvest to the British engineering trades.

The Federal Capital.

I have left to the last, however, the biggest national scheme on the tapis. I refer to the building of the Federal Capital of Australia. No reliable estimate of the amount involved in creating a beautiful city in the bush of Australia has been produced, but my friend Senator Styles, no mean authority, talks in millions when he is criticising the public buildings proposed for the capital alone. This much, however, the merchant and manufacturer having business with Australia should know : the tendency in the National Parliament is to select the site at once and push on with the erection of necessary buildings without delay. Australian legislators want a worthy home of their own. Provided there be decent wool and grain harvests in 1904–5, and no sudden draught sets Australia back on its haunches once more, these gentlemen will get their way, and hundreds of thousands of pounds will find their way to London, Glasgow, Manchester, Sheffield, and Belfast, for the myriad essentials of city life which even the nimble-witted Australian cannot manufacture for himself.

Mining Prospects.

Besides shouldering the vast undertaking already touched upon, the tired Governments of the Commonwealth will soon have to do something to improve the prospects of the mining districts. The success of the State Battery System in West Australia will lead on to imitating action in other States. The experiments in mining machinery described from time to time in Page's Magazine are followed with keen interest at Coolgardie, Kalgoorlie, Ballarat, and Bendigo, and will bear fruit in improved methods. These must inevitably react upon the British firms, and lead to satisfactory results. The mining market has been spoilt as a safe speculative field by the conscienceless and diabolical frauds foisted on to the "thrifty" Australian during the past decade, but the number of sound properties is sufficient to render Australia a splendid "dumping ground" for American machinery. British engineering firms need to watch every move made by semi-Socialistic Governments to aid the mining industry, if they value their Australian connection at all.

MINING NOTES.

By A. L.

The Colliery Exhibition.

The second annual Colliery Exhibition at the Royal Agricultural Hall, Islington, N., proved a decided advance upon its predecessor. The features of the exhibition were so well summed up by Sir Lees Knowles, Bart., M.P., who performed the opening ceremony, that I cannot do better than quote from his remarks. He showed that this year there were upwards of 125 exhibitors, as compared with 71 in 1903. Although the attendance at the previous exhibition had been small, it was of the right order; and the fact that almost every exhibitor was again represented in the present exhibition spoke volumes for the business done. The exhibits might be roughly classified under four headings: (1) Machinery used in the opening out and development of collieries; (2) machinery used in the preparation of coal for sale or use; (3) machinery used in the transport and handling of coal; (4) appliances to effect economies in consumption. These practically are the four sections into which the Royal Commission on Coal Supplies divided their inquiry. In regard to the present exhibition, it could not be expected that it would be wholly representative. This was so particularly in the case of the heavier plant, such as winding engines, dynamos, boilers, haulage gear, etc., which would be obviously out of the question in an exhibition of such short duration. It was, perhaps, to be regretted that makers of this class of colliery plant had not thought fit to display working models, as largely in evidence on the stalls of German exhibitors at the Düsseldorf Exhibition of 1902. In regard to one class of machinery, the present exhibition appeared to be of a thoroughly representative character, viz. —electrical apparatus. The findings of the Departmental Committee appointed by the Home Office had been of such a definite character that manufacturers had been able largely to anticipate the ultimate adoption of the new rules. Many novelties in electrical apparatus were therefore being shown by exhibitors.

The Use of Electricity in Mines.

Discussing the use of electrical apparatus for mining purposes, Sir Lees Knowles remarked that, rightly or wrongly, we assumed a very high standard of safety in this country, which was strongly evidenced by the severe restrictive character of the Coal Mines Regulation Act. There was the further point that British colliery managers above all prided themselves on their pitmanship, and had been loth to make experiments with a force of so capricious a nature and about which so little was known as electricity. There had in the past been too great a feeling of reserve between the mining engineer and the manufacturer of mining plant. Both had persevered according to their several lights, but many questions had for this reason been left unsolved, which could speedily have been settled if the two had joined forces. The exhibition provided an excellent opportunity for an interchange of opinion. On the part of the manufacturer it was only fair to say this secretiveness had been largely prompted by the unsatisfactory protection afforded by our patent laws. These had acted in other ways. One of the greatest extensions in the use of electricity might be looked for in the increased adoption of polyphase current, which, so far as this country was concerned, had been severely retarded by the lack of facilities for the taking out of licences. Some important patents in regard to three-phase generators only lapsed last year, and great developments might be confidently looked for during the next few years. In giving evidence before the Royal Commission, a prominent mining engineer pointed out that one of the greatest deterrents to the use of labour-saving machinery, except with the very largest collieries, had been the great prime cost.

Economical Power Production for Collieries.

Some of the largest installations on the Continent, such as those at Harpen, in Germany, the Grand Hornu, in Belgium, and Marles, in France, had only been rendered possible by the fact that they were able to generate power at a central station for large aggregations of pits. The same tendency was steadily growing in this country, where the necessity of taking the output from several collieries in order to render an expensive by-product coking plant a paying venture, had to some extent solved the question of power generation. There would, without doubt, be a great development in the generation of high-tension current at central stations from the coke-oven gas, which would be distributed to the various collieries supplying the ovens, and used for service in the mines. In order to facilitate this, it was to be hoped that the Board of Trade would see fit to relax their regulations as to the transmission of high-tension current by bare overhead wires. Where, for various reasons, it was impossible to effect this amalgamation of interests, great assistance might be looked for from the power companies, which were coming into being in almost every coalfield in the country. One of the results to be anticipated from these developments was the increased use of electricity for winding. In Great Britain the pits winding by electricity might be numbered on the fingers of one hand, but bearing in mind the extensive use of electric current for this purpose on the Continent, and the many advantages which it had been clearly proved to hold out, the electric winding engine might be safely regarded as one of the things that must come to the front. Other advances that might be anticipated principally lay in the standardisation of electric fittings and appliances, which should be the most effective safeguard against accidents.

In addition to electrical apparatus shown at the

Agricultural Hall, there were numerous exhibits of pumping and ventilating plant, together with miscellaneous accessories used in collieries, and automatic couplings were again a prominent feature.

Mining Statistics for 1903.

In 1903 the total number of persons employed in the United Kingdom at all mines and at quarries more than 20 ft. deep was 970,044, an increase of 17,333, or 1·8 per cent., on the previous year. At mines under the Coal Mines Act the increase was 17,275 persons (2·1 per cent.), at mines under the Metalliferous Mines Act there was a *decrease* of 989 (3·2 per cent.), and at quarries under the Quarries Act an increase of 1,047 (1·1 per cent.).

The numbers of females included in the surface workers were 5,380 (or 3·2 per cent.) at coal mines, and 268 (or 2·2 per cent.) at metalliferous mines. Of the underground workers at coal mines 45,234 (or 6·7 per cent.) were boys under 16.

The numbers employed at coal mines increased in every district, except Stafford and Ireland, where slight decreases took place.

The total output of coal during the year was 230,334,469 tons, an increase of 3,239,427 tons (or 1·4 per cent.) on the previous year.

The total output of iron ore was 13,715,645 tons, an increase of 289,641 tons, or 2·2 per cent., over 1902. As regards certain other minerals, the total output in tons was as follows: oil shale, 2,009,602; clays and shale, 16,198,021; chalk, 4,469,974; limestone (other than chalk), 12,222,971; sandstone, 5,409,502; igneous rocks, 5,425,538; slate, 531,612; gravel and sand, 2,245,757; salt from brine, 1,719,223.

At coal mines in 1903, there were 1,036 separate fatal accidents, causing 1,072 deaths, an increase of 117 accidents and 48 deaths as compared with 1902. At metalliferous mines there were 25 deaths from accidents (a decrease of 4), and at quarries 95 deaths (a decrease of 24).

Of the 1,072 deaths at coal mines 917 were underground, and of these 567 were due to falls of ground, 69 to shaft accidents, 14 to explosions of firedamp or coal dust, 176 to haulage accidents, and the remainder to various other causes. Of the 155 deaths on the surface 81 were due to accidents on railways, sidings, or tramways.

The accident death-rate at mines under the Coal Mines Act in 1903 was 1·35 per 1,000 persons employed underground. The average rate for the preceding ten years (1893–1902) was 1·52; for the ten years 1883–1892 it was 2·01; and for the ten years 1873–1882 it was 2·57. These figures show a satisfactory decline in death-rates.

At metalliferous mines the death-rate of the underground workers was 1·20 per 1,000, and at quarries, for workers inside the excavations, 1·34 per 1,000.

Winding Plants for Great Depths.

I have received from the Secretary of the Institution of Mining and Metallurgy two volumes which are of very special importance at the present time, one being a compilation of 444 pages devoted to winding plants for great depths, by Mr. Hans C. Behr, with discussion, while the other volume is a valuable collection of plates illustrating the paper.* About three-quarters of the first volume is devoted to discussion. It has been edited by Sir Clement Le Neve Foster, F.R.S., Arthur C. Claudet, A.R.S.M., and C. McDermid (Secretary). A prefatory note by the latter calls attention to the fact that in the preparation of this work the Institution of Mining and Metallurgy received the co-operation of the South African Association of Engineers, and the volume will form part of the proceedings of both Societies. The author deals with the subject of deep-winding with special reference to the problems that now present themselves on the South African Gold Fields. The Council of the Institution of Mining and Metallurgy, foreseeing the interest that the paper would attract in South Africa, and the advantages of a local discussion, invited the South African Association of Engineers to present the paper to their members, an invitation that was cordially accepted.

A large number of papers, which have required much time and study in their preparation, were contributed by engineers resident on the Rand, to whom the subject specially appeals, owing to the large number of deep shafts that are projected there at the present time. The discussion in Johannesburg turned chiefly on the merits of the drum and sheave systems of winding respectively, which were dealt with on each side in an exhaustive manner. It was hoped that an introduction would have been contributed by the late Sir Clement Le Neve Foster, in addition to his valuable services as editor, but his lamented decease, while the work was going through the press, rendered this impossible. The thanks of the two Societies are tendered to Mr. W. Fischer Wilkinson for valuable assistance in the preparation of the volume, and to Mr. E. J. Laschinger, for compiling the index.

Enter John Chinaman.

The current issue of the "Mining Journal" has an interesting series of views illustrating the arrival of the Chinese on the Rand, and more particularly the Comet Compound, at which the coolies are now located. It is recorded that the compound has been whitewashed and disinfected, and the sleeping compartments overhauled. The kitchen, with its twenty steam pots, was in use early in the day, preparing a comfortable meal of rice, meat and cabbage for the expected travellers. A spacious dining-room is also in course of erection. Excellent bathing arrangements are being made in the compound. A large plunge is already in existence. Shower baths are being installed, and there will be a long row of washing basins and tubs, hot and cold water being laid on. The compound will accommodate 2,000, and another 1,000 will be located at the Cason Mine.

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* See also "Notable British Papers."—Ed.



OUR TECHNICAL COLLEGES.

SIR WILLIAM WHITE AT BRISTOL.

At the opening of a large building with special workshops for technical trade teaching, in connection with the Merchant Venturers' College, Bristol, Sir William White was able to congratulate that institution upon its great progress. Dealing with the importance of technical education, he emphasised the value of instruction given to artisans in evening classes. He was delighted to find that whereas there were 232 entries in their evening classes in 1890, last year there were 2,250. He suggested scholarships of sufficient value to enable poor but capable students to pursue their studies without anxiety as to the means of living. He favoured single authority in each district for the control of education, and wanted to see everyone, however poor, have the opportunity of developing latent talent.

THE ROYAL INDIAN ENGINEERING COLLEGE AT COOPER'S HILL.

The Secretary of State for India in Council has now arrived at a decision as to the date of closing the Royal Indian Engineering College at Cooper's Hill. The prospectus for 1904 states that the College will be permanently closed at the end of the Session of 1905–6, and that the Entrance Examination to be held in July of this year, under the conditions explained in the prospectus, will be the last.

PRIZE DISTRIBUTION AT KING'S COLLEGE.

The annual prize distribution at King's College was undertaken by Sir John Wolfe-Barry, who delivered an instructive address. The report on the year's work, presented by Dr. Headlam, stated that though there had been no great or important change during the twelve months, the year had not been an unprosperous one, for in most directions there had been an increase of students, and they had represented a higher standard of regular work. Still more, a steady re-organisation had been in progress.

It was mentioned incidentally that the engineering faculty had been increased by additional demonstrators, one in electrical engineering, one in geology, and one in chemistry. They had also been able to double the size of the electrical engineering laboratories, and to make arrangements for work in electric traction. Altogether they could, he thought, give a very good engineering training.

SUGGESTIONS BY SIR JOHN WOLFE-BARRY.

In the course of his address, Sir John Wolfe-Barry said they recognised progress in every branch. In the Faculty of Science there had been great developments. The amount of time given to science now was immensely greater than it was when he was a boy, and it was a matter for congratulation that that was so. What was being done in that college was being done else where, and they were sending a great scientific army into the world such as was not dreamed of 30 or 40 years ago. But they could not help recognising that very much remained to be done. It was, in the first place, very desirable that more money should be furnished for the pursuit of science. In the second place, more time ought to be devoted to the subject, and those who were about to pursue it should come up to the colleges with better preparation. He had no hesitation in saying that a great part of the first year of a man's life in a college was lost in repairing deficiencies which ought to have been repaired in the secondary school. He hoped the secondary schools of the country would recognise the matter and would rise to the occasion.

It must be a great source of gratification to all connected with King's College that its professor of engineering, Professor Capper, was the University professor. It afforded him great pleasure when, on the Senate of the London University, he heard that his old college was to have the University professor of engineering located in the Strand. Engineering was a subject very dear to his heart. His experience of it had convinced him of the absolute necessity of practical training in engineering shops. The mode of imparting that practical training had received very considerable stimulus by the introduction of what was called the "sandwich system," under which professional students could take their scientific training at the college during one period of the year and their practical training in the shops at another. Under this system the number of weeks' training undergone in the course of a year was increased. The traffic of London was a problem with which, no doubt, some of the engineers of the future would have to deal, and he could not help thinking that in connection with this matter some of the young members of the engineering profession would find some work in their future lives. He commended the subject to their earnest consideration.

NOTES AND NEWS.

Three new gold dredgers for the Burma Gold Dredging Company, are being constructed by Messrs. Lobnitz and Co., Ltd., Renfrew, to the designs of Messrs. Cutten Bros.

Messrs. Mather and Platt, Ltd., of Salford Iron Works, Manchester, have received an order from the Crown Agents for the Colonies for a small alternator for Lagos. This machine will be direct-coupled to a Belliss engine, running at 480 revolutions per minute, and will give an output of 60 kilowatts at a pressure of 1,000 volts, with a frequency of 80 cycles per second, and will be provided with a direct-coupled exciter.

On June 1st last, the Union Switch and Signal Company, who are the sole makers of the Westinghouse Electro-Pneumatic System of Signalling in America, had in course of erection in their shops fifteen locking frames with a total of 519 levers. As the principal of signal selection is carried out very thoroughly in the States, this number of levers may be taken as equivalent to between 700 and 800 mechanical levers.

An interesting Admiralty contract, obtained by open tender, is being carried out by Messrs. Graham, Morton and Co., of Leeds and London, in connection with the electricity supply at the Royal Dockyard, Chatham. This includes the supply, delivery, and erection of a complete coal-handling plant, with coal bunkers, stanchions, girders, flue, uptakes, coaling cranes, coal weighing apparatus, and all the accessories appertaining thereto.

The Works Committee of the Metropolitan Asylums Board have recommended that Messrs. Meldrum Bros., Ltd., of Atlantic Works, City-road, Manchester, instal and fix mechanical stokers (1) in connection with four boilers at the Grove Hospital, (2) in connection with four boilers at the Park Hospital, (3) in connection with two boilers at the Northern Hospital. This is in addition to an order now in hand for another of their institutions for three sets of stokers.

The 9 ft. fans for the Preston Corporation cooling towers have been constructed by Messrs. Matthews and Yates, Ltd., of Cyclone Works, Swinton, Manchester, for Messrs. Donat and Co., of Manchester. Similar fans have also been supplied by this firm to the Klein Engineering Company, Ltd., for Calcutta. As specialists in refuse removal, they are carrying out a large order from the Brush Electrical Engineering Company, Ltd., Loughborough, for a Cyclone collecting plant.

The Northampton Institute Day students closed a successful session with the gathering for their annual dinner at Anderton's Hotel, Fleet-street, on July 8th. Though a comparatively new engineering college, it is the earnest hope of both past and present students that their future record may be such as to place the Northampton Institute on a level with the older colleges. The following members of the staff constituted the guests of the evening: Dr. R. M. Walmsley, Dr. C. V. Drysdale, Messrs. C. E. Larard, S. Field and W. E. Curnock.

A large party of the Birmingham Association of Mechanical Engineers recently inspected the works of Messrs. Thomas Firth and Sons, at Sheffield. The principal interest centred in the crucible steel processes. A visit to the file works showed that whereas five years ago these tools were made by hand they are now produced in enormous quantities by machinery. Messrs. Firth can show that although watch and clock making is a prosperous industry in the hands of foreigners, they have to go to Sheffield for steel to make their springs, one firm in Switzerland taking no less than 150 tons per annum. After lunch the party visited the gun works.

From Messrs. Longmans, Green and Co. we have received one of Professor D. A. Low's useful celluloid diagram measurers. This is an instrument which can be employed with advantage in measuring the areas of irregular figures, and more particularly for determining the mean effective pressure from indicator diagrams from steam, gas, and other engines. We are assured that, with very little practice, the mean effective pressure can be determined with this instrument almost as quickly as with an expensive planimeter, and with sufficient accuracy for all practical purposes. It is produced for 1s., with instructions complete.

On July 14th a number of members of the Civil and Mechanical Engineers' Society, under the guidance of Mr. A. S. E. Ackermann (hon. sec.), visited the new Government Offices in Parliament-street, Westminster, and the new War Office buildings in Whitehall. By a coincidence much to be regretted, Mr. J. M. Brydon, the architect of the new offices, and Mr. W. Young, who designed the new War Office building, have both died since the inauguration of the work. The superintending architect in the first case is Sir Hy. Turner, while the present architects of the War Office building are Sir John Taylor and Mr. Clyde Young. The Parliament-street buildings will not be ready for occupation for about three years. Some idea of their size may be gained from the fact that there are three-quarters of a mile of corridors on each floor, and over seven miles of flues in the walls. The War Office buildings, which are more advanced, cover about 3¾ acres.

COMING EVENTS.

August.

6th.—North of England Institute of Mining and Mechanical Engineers: Annual Meeting at Newcastle-on-Tyne, at 2 o'clock.—The Mining Institute of Scotland: Excursion to Houldsworth Pit, Dalmellington.

NOTABLE BRITISH PAPERS.

A Monthly Review of leading Papers read before the various Engineering and Technical Institutions of Great Britain.

WINDING PLANTS FOR GREAT DEPTHS.

THE following extract is taken from Mr. Hans C. Behr's paper on "Winding Plants for Great Depths," which has recently been discussed by the Institution of Mining and Metallurgy and by the South African Association of Engineers.*

In many extensive deep-level mining operations, thanks to modern large-scale methods, the present works are being so rapidly exhausted of their ore that, in order to be able to continue the enterprise further, developments at still greater depths become necessary. A depth of nearly 5,000 ft. has already been reached in the Lake Superior copper region, and the proposition of depths exceeding this is at present being seriously considered.

ALTERNATIVE SCHEMES.

The chief and most difficult problem with increased depth is that of the winding plant. A number of different arrangements have been proposed as a solution. Opinions seem mainly divided on the question as to whether it would be possible or economically preferable to raise the load in a single lift from, for example, a depth of 6,000 or even 8,000 ft., or whether it might not be necessary to resort to winding in stages with intermediate dumping and loading stations. The single lift for such depths necessitates taper ropes, the manufacture of which, however, presents no difficulty, while the wear ought reasonably not to exceed that of ordinary ropes under similar conditions.

For great depth, however, the long and heavy ropes necessitate massive conical drums, with large ratio of end diameters, in order to avoid negative moments near the end of the trip. The load of ore has also to be increased, in order to maintain the output from the greater depth, without exceeding a given maximum speed in the shaft; while large moments of inertia make it necessary to greatly extend the periods of acceleration and retardation. If the period of acceleration is not extended, the engines for a single lift from a great depth must be larger to correspond with the extra acceleration moment.

The Koepe or Whiting systems (which use sheaves instead of drums, thus driving the ropes by friction) though having, in most executed examples, with drums of insufficient diameter, a comparatively small moment of inertia, are not well adapted for great depths in a single lift, because they cannot employ taper ropes. The tail-rope which they require is also objectionable in most cases.

Stage winding, with independent winders for each stage, obviously requires that different sections of the shaft be offset from each other, and overlapping, so that the skips or cages of two consecutive sections can reach relative positions suitable for transfer of the load from one to the other.

UNDERGROUND WINDERS REQUIRING POWER TRANSMISSION.

If hauling in the lower stages be performed by underground winding machinery, this probably could not well be operated by the direct use of steam led from the surface, or derived from underground boiler plant, but would require some method of power transmission, like electricity or compressed air, the latter with reheating arrangements, so as not to be too wasteful in operation. The cost of either of these two systems, consisting of power-generating plant with boilers, surface and underground winders, carrier for transmission medium, and underground excavations, would naturally greatly exceed that of the single-lift winder, notwithstanding that the latter must operate, in order to maintain the same capacity, with a much greater load than that used with stages. In additon to the double number of attendants required for the winding plant proper, in the case of two stages, there would be the extra ones needed for the power-generating plant, so that the attendance cost would be almost trebled. Some reserve to the power plant must also be provided, since the chance of accident to the latter, as well as to the winders, has to be considered. The transmission losses would probably be heavy, owing to the variable demand for power. If a number of winders could be operated from one power plant in such rotation that a more uniform load would result on the power plant, then the latter could be made smaller, and would also, owing to the more uniform load, operate more economically. In this case the possible economy gained might, perhaps, particularly where fuel or other source of power is very costly, be sufficient to overbalance the higher interest, depreciation and attendance charges, together with the transmission losses and greater risk of shut-downs, and therefore warrant the installation of such a plant. Considerable uncertainty prevails, however, as to the actual steam consumption of steam-winding engines. The writer is not aware of any published reports of reliable tests. Such tests would be very desirable in order to enable proper comparison with steam-driven power transmission to operate winders. At the same time, it should be borne in mind that fuel is often not the main expense, and that it can and does sometimes cost more to get great economy of fuel than the cost of the fuel saved through it amounts to.

JOSEF HRABAK'S SCHEME.

For winding from a vertical shaft in not more than two stages, Josef Hrabák, of the mines at Przibram, in Bohemia, as far back as 1884, proposed a plan which consists in placing the winders for the lower stage also at the surface and leading the rope to the bottom, but only winding to the point where the upper stage begins. Winding from inclines to the foot of a vertical shaft has often been accomplished in this manner at much earlier dates, and the system may therefore be

* Published in two vols., with full discussion and plates by E. and F. N. Spon, "The Engineering and Mining Journal" (New York), and by the Institution of Mining and Metallurgy.

said to have undergone the test of actual practice. Hrabák again presented his arguments for this system at the Paris Mining Congress in 1900.*

RELATIVE COST.

Tapering ropes are obviously the only kind to be considered for the lower stage with engines at the surface. Such a plant would be cheaper in first cost than underground winders requiring a system of power transmission to operate them. The attendance cost would also be less, through the absence of the power-generating plants. With regard to the possibly lower steam-economy of even high-class steam winders operating not intermittently but concurrently, the same remark would apply as in the case of the single lift winder, though not to the same extent. The two steam winders at the surface might, however, as mentioned in the case of underground winders operated from a power-transmission plant, be worked in such rotation that the demand on the boiler plant would be much more uniform than when operating a single winder, so that a smaller boiler capacity might suffice. The single-stage winder would considerably lower the steam pressure during the trips, unless the boiler plan were proportionately very large; while even for short stops, steam would probably begin to blow off at the safety-valves. It also seems probable that, even without considering a reduction in size of boiler capacity the two-stage winding-plant on this plan would not cost more than the large single winder if, instead of continuing the shaft compartments for the lower stage up to the surface as proposed by Hrabàk, they were arranged as for underground winders. The ropes for the lower stage could then be led down and guided at the side of the upper stage compartment, or placed in the ladder and pump compartment, as is frequently done in winding from an incline starting from the foot of a vertical shaft. With such an arrangement diverting sheaves would necessarily have to be used at the offset between the two stages.

THE TANDEM SYSTEM.

Another system of stage winding with drums at the surface has recently been proposed. It consists principally in attaching the rope for the second stage to the bottom of the skip or cage for the upper one so that one winder only is needed for operating both stages, thus requiring no more engine-drivers than the single lift. For want of a conventional designation, this will be referred to in the present article as the tandem system. Off-setting the sections of the shaft for the upper and lower stages becomes unnecessary with this arrangement when cages are used, and could also be avoided with self-dumping skips, if proper trap-doors be arranged to be automatically operated by the upper skip when it reaches its loading position, so as to close off the shaft below it and receive the spill incidental to loading. If such trap-doors be made inclined, the spill could be diverted into a bin arranged at the side of the shaft. The spill might be raised periodically from the bin by a small bucket and winch to the loading bin directly above, as is done in other cases where skips are loaded from bins in shafts or inclines.

The cost of the winders for the tandem plant would be less than for any other system; but there are other items which would about make up for this saving, and there will no doubt be inconveniences in operating by this, so far as the writer knows, untried system. It ought, however, to be applicable with advantage in some cases.

Where power from water or fuel can be obtained by transmission from a distant point more cheaply than by generating it on the spot, such provision should be utilised; but it would not, even in this case, be necessary to transmit the power to underground winding plants for a second stage. It would doubtless be better to keep such machinery on the surface, and operate the second stage by leading the ropes for this to the winder at the surface.

Beyond two stages it will probably be necessary to resort to underground winders operated by electricity or re-heated compressed air; but such plants would probably be small compared with the rest of the winding plant, since it does not seem likely that very much greater depth than can be controlled by two stages will be reached for some time to come. This view of the matter was also taken by Hrabák in his paper already referred to.

The questions as briefly outlined above can, however, only be decided by reference to conditions governing each case, and after thorough analysis of the merits of different types and varieties of apparatus.

* *Bulletin de la Société de l'Industrie Minérale, Congrès International des Mines et de la Métallurgie*, Exposition de Paris en 1900.

THE DESIGN AND TEST OF A MODERN STEAM-POWER PLANT.

MR. EDWARD G. HILLER, of Manchester, recently gave the Institution of Mechanical Engineers some interesting particulars of the construction and test of a Modern Factory Steam plant which has been "designed with the object of obtaining good commercial economical results."

By commercial economical results is meant, that the object in view was not simply to obtain an engine which would use the smallest number of pounds of steam per indicated horse-power per hour, but one which would, taking account of the capital, maintenance, fuel, water, and other incidental expenses, produce the power required on the flywheel at the lowest total cost for steam plant.

This plant has now been running for about twelve months at the mills of the Bessbrook Spinning Company Bessbrook, Co. Armagh (see illustration). The specifications and general design of the plant were prepared by the Consultative Branch of the National Boiler and General Insurance Company under the direction of the author, and the supervision of the construction of the engine was carried out by the staff of the company.

The alterations at the Bessbrook Mills are an interesting example of the advantage of converting a group of old mills, driven by separate and independent steam-engines, to a method of driving from a central station with more modern and economical plant.

In the case of the Bessbrook Mills, the buildings formed three sides of a quadrangle, with one wing forming an extensive weaving-shed driven previously by a separate horizontal cross compound tandem engine with horizontal air-pump. The other wing was driven by bevel gearing from the main block.

The main block itself consisted of two mills placed end to end with each portion driven by separate engine. One of these engines was an old pair of beam engines, and the other engines were a pair of double tandem compound horizontal engines. The three engines drove by gearing, there being altogether three upright shafts and three sets of horizontal second motion shafts.

The most suitable site for the new engine was on the side of the mill furthest from the present boiler-house, and consequently an exceptionally long steam-pipe range was necessary. Due account had to be taken of the high price of coal at Bessbrook (which may be taken approximately at 16s. per ton), the necessity for avoiding breakdowns, the isolated position of the mills in the country, and their distance from any large engineering centre, where, in the event of break-down, skilled workmen could be readily obtained.

It was decided to have the engines of ample power in order to allow for any subsequent extensions. The engines were therefore constructed to develop, if necessary, under regular work, at least 1,500 i.h.p. without material falling off in economy.

GENERAL ARRANGEMENT OF PLANT.

The plant consisted of the following :—

Three Lancashire Boilers, 8 ft. by 30 ft., at 160 lb. ; two boilers being required for the load, the other being a spare.

One Green's Fuel Economiser, 224 pipes.

Three Musgrave and Dixon Superheaters, one to each boiler, 217 square feet heating surface each.

10-in. Main Range Steam-Pipes.

4-in. Feed Ranges.

One Weir Feed-Pump. (Stand-by.)

1,200-i.h.p. Cross Compound Engine, 25-in. and 52-in. cylinders by 5-ft. stroke, working at 65 revolutions.

The feed-water for the boilers is taken from the discharge of the jet condenser ; it is then pumped into the economiser and passed through it into the boilers. The steam passes from each boiler through the superheater in the down-take flue at the back of the boiler, and thence to the main steam range, by which it reaches the engine.

BOILERS

The three boilers, which are of the standard Lancashire type, are provided with the usual fittings. Two of the boilers are sufficient for the load. The boilers have the ordinary furnace fronts and are hand-fired. Poulton's blocks were used for the setting. The tops of the boilers and the front end-plates are covered with magnesia composition ; in addition, the boiler fronts are protected by blue planished steel casings.

The principal dimensions of the boilers are as follows :—

Internal diameter inside inner rings, 8 ft.
Internal length, 30 ft.
Internal diameter of furnace tubes, 3 ft. 2 in.
Thickness of shell plates (mild steel), $\frac{13}{16}$ in.
Thickness of flue tubes (Adamson flanged seams, mild steel), $\frac{9}{16}$ in. (end rings, $\frac{11}{16}$ in.).
Thickness of end plates mild steel, $\frac{11}{16}$ in.
Diameter of junction valves, 7 in.
Diameter of feed valve, $2\frac{1}{2}$ in.
Intended safety-valve load, 160 lb. per square inch.

SUPERHEATERS

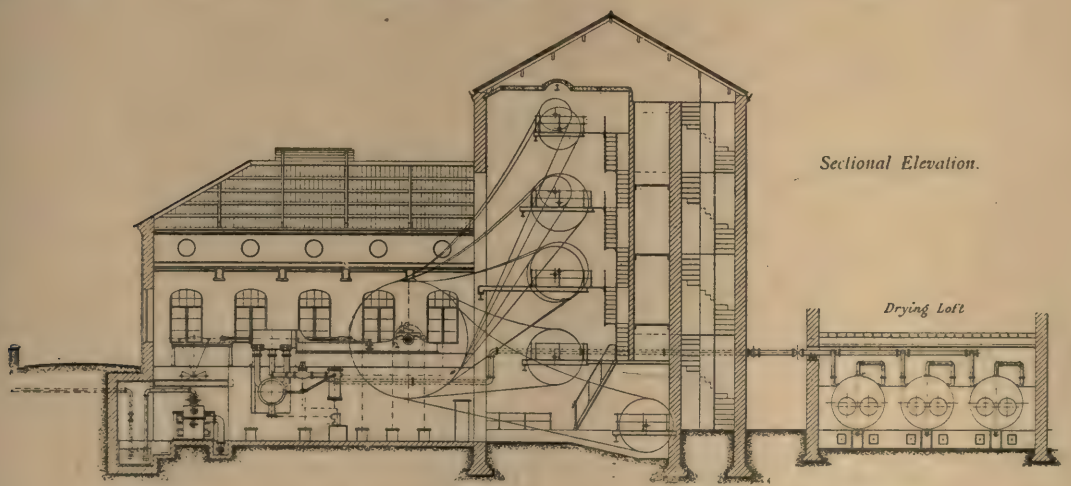
These are of the Musgrave and Dixon type. One is placed behind each boiler, and is traversed by the flue gases immediately on leaving the furnace tubes. Each superheater consists of 35 **U** tubes of solid-drawn steel, arranged in parallel ; the tubes are $1\frac{5}{16}$ in. outside diameter, and about 15 ft. total length. The heating surface is 217 square feet, and the area of passage for the steam is equivalent to that of a $7\frac{3}{8}$ in. diameter pipe. The tube plate $1\frac{1}{4}$ in. thick is made of mild steel, while the top box is of cast steel. Thermometer pockets are arranged before and after the superheater.

STEAM PIPES.

The steam-pipe range is of mild steel and 10 in. diameter.

The total length of the 10-in. piping is about 145 ft., and next to the engine there is about 10 ft. of 9-in. diameter piping. A drop leg, of 21 in. internal diameter and 4 ft. 6 in. high, is fitted immediately before the main engine stop-valve, and the pipes are arranged with a fall from the boilers to this point. The straight lengths are lap-welded, and the bends, tees, and elbows are of cast steel.

(*To be continued*).



GENERAL ARRANGEMENT OF ENGINES, BOILERS, AND ROPE DRIVE, BESSBROOK.

NOTABLE PUBLICATIONS.

"THE NAVAL POCKET-BOOK, 1904."

By Sir W. Laird Clowes. W. Thacker and Co. 7s. 6d. net.

The Naval Pocket-Book, which has now reached its ninth year of publication, contains a considerably larger number of pages than the previous issue. The increase in size is synchronal with its increase in usefulness. Under the direction of Sir William Laird Clowes, who now resumes the active editorship, a number of new features have been introduced; the list of Dry Docks has been thoroughly revised and extended, while the data dealing with the Navies of the World has been brought up-to-date. Mr. Allen H. Burgoyne (whose paper on The Future of the Submarine was dealt with in last month's PAGE'S MAGAZINE) contributes an important chapter entitled, "The Progress of the Submarine Vessels." The year 1903, he remarks, has been remarkable chiefly for the way in which the submarine vessel has received general recognition as a valuable naval asset, by nearly every Power possessing a great navy. It is also noticed that, whereas the progress of submarines in both France and the United States has come somewhat to a standstill—probably to allow the authorities of these two countries to gain as much knowledge as possible from experiments with those already built or under construction—in England, Russia, Germany and Italy the numbers of this type of vessel are being augmented to an unprecedented extent. Amongst other articles worthy of special attention, may be mentioned, "Notes on Torpedoes," "Personnel of the Leading Navies," "Plans of Ships," and the "Classified and Analytical List of the Navies of all Nations."

"RADIUM AND ALL ABOUT IT."

By S. R. Bottone. Whittaker and Co. 1s. net.

A popular account of the circumstances which led up to the discovery and extraction of radium, including some theoretical considerations on radio-activity and the properties of Radium.

"NOTES ON ALTERNATE CURRENTS FOR STUDENTS."

By Harold H. Simmons, A.M.I.E.E. Cassell and Co. 1s. 6d. net.

Students of electrical engineering will find this small book a work of real value; it contains in a condensed form the lectures delivered by the author at the Finsbury Technical College, to which the numerous diagrams will prove helpful additions.

"THE MINER'S GUIDE"

To the Coal Mines Regulation Acts and the Law of Employers and Workmen. By L. A. Atherley Jones, K.C., M.B., and Hugh H. L. Bellot, M.A., B.C.L. Methuen and Co. 2s. 6d.

Although specially designed for miners this handy compendium should be found useful to all classes of workmen. The author's object has been to compile a digest of those provisions especially affecting the relations of employer and employed. The Truck Acts, Weights and Measures Acts, and the Explosives in Coal Mines Order are extensively dealt with, while considerable space is devoted to the Employers' Liability Act and Workmen's Compensation Acts. It contains the most recent decisions of the Courts, and special attention is given to the Law of Conspiracy, and those affecting Trade Unions, which should be found useful in indicating to members of Trade Unions the measure of their responsibilities and that of their officers in trade disputes. A table of cases and a good index further enhance the value of this useful book.

"GASWORKS."

Their Construction and Arrangement, and the Manufacture and Distribution of Coal Gas. Originally written by Samuel Hughes, C.E. Ninth Edition, revised, with Notices of Recent Improvements, by Henry O'Connor, A.M.Inst.C.E. Crosby Lockwood. 6s.

In bringing this well-known work up to date, Mr. Henry O'Connor, the author of "The Gas Engineer's Pocket Book," adopts the point of view of the student and the manager of small works. He takes a wide survey of all the recent processes used in gas manufacture, including Mond gas, Acetylene, and Carburetted Water Gas, Coke Conveying and Elevating, Regenerative Settings, and Benzol Carburetting, to which is added a description of the apparatus which has been improved and more generally adopted during recent years. Discussing some of the improvements lately introduced in the construction of street lamps, the author thinks that the great advances made in the design of our gas establishments, public buildings, and streets, demand an improved appearance in the lanterns, brackets and columns in our thoroughfares, which would undoubtedly contribute to further the progress of gas lighting.

Throughout the book we find evidence of sound practical experience and the editor is to be congratulated on the general excellence of his work, which is greatly elucidated by the many diagrams and folding illustrations.

OUR DIARY.

June.

22nd.—Serious fire in the Salisbury Mine, Johannesburg.—It is announced that the Royal Indian Engineering College at Cooper's Hill will be closed at the end of the Session 1905-6.—The first batch of Chinese labourers arrive at the Rand.—The first through passenger train to the Zambesi Victoria Falls leaves Capetown.

23rd.—A new commercial treaty between Belgium and Holland is signed at the Belgian Ministry for Foreign Affairs.—Official confirmation of a commercial treaty between Germany and Belgium.

24th.—Lord Lilford opens a new foundry at the Irthlingborough Iron Works.—Sir J. Lister Kaye secures the definite ratification of an iron mines concession in Ngan-whei, China.

25th.—Opening of the Leek and Manifold Railway.—Major-General Hutchinson, C.B., inspects the new line and dockyard at Dover, which are to be used in connection with ocean liners making Dover a port of call.—Opening of the Colliery Exhibition.

27th.—His Majesty the King and Emperor William visit the Germania dockyard.—Opening of Sheffield's new generating station.

28th.—The wreck of the Danish emigrant ship *Norge*, on Rockall, in the North Atlantic, entails the loss of several hundred lives.—The Institution of Electrical Engineers holds its Annual Conversazione.

29th.—Annual Convention of the Incorporated Municipal Electrical Association opens at Derby.

30th.—Electric traction is brought into force on thirty-seven miles of North-Eastern Railway in the neighbourhood of Newcastle.—Opening of the Harrow and Uxbridge Railway.—An agreement has been signed by which the De Forest Wireless Telegraph Syndicate acquires all the Maskelyne wireless patents.—The revenue of New South Wales for the past financial year was £11,453,744, as compared with £11,532,230 in 1902-1903.—The revenue of Victoria for the past financial year amounted to £7,310,366, showing an increase of £341,401.—The revenue of South Australia for the past financial year amounted to £2,510,783, showing an increase of £27,863.

July.

1st.—The new ocean pier at Dover used for the first time for transatlantic traffic.—Opening of a motor service by the London and South-Western Railway Company on the Alton and Basingstoke line.

2nd.—The Queensland Treasury returns show that the revenue for the financial year amounts to £3,583,000, as compared with £3,526,500 in the previous year.—The *Times* reports that the Great Northern Railway of Canada fails to pay the interest on the bonds due yesterday.—The Court orders a foreclosure sale of the properties of the United States Shipbuilding Company.

4th.—Dr. Barton meets with a serious accident while superintending the inflation of his balloon.—A House of Lords Committee meets to consider the bill promoted by the L.C.C. to authorise the provision of a service of passenger steam-boats on the Thames.

6th.—Sir John Wolfe-Barry distributes the students' awards at King's College.

7th.—Lord Windsor opens the new waterworks at Uppington.

8th.—The superintending civil engineer of the new dockyard at Gibraltar begins letting water into King Edward's dock.

12th.—A trial takes place on the Thames of a first-class torpedo-boat fitted with a combined system of steam turbine and ordinary reciprocating engine.—M. Cambon, the French Ambassador, lays the final stone of the new pier and harbour works at Folkestone.

13th.—Launch of the new Cunarder *Caronia*, at Clydebank, Glasgow.—Launch at Dumbarton of the steel turbine steamer *Ghasa*.

14th.—Princess Henry of Battenberg visits Bristol and Portishead to lay the foundation stone of a National Nautical School.—Death of Ex-President Kruger.

15th.—The North-Eastern Railway Company announce that the new entrance to their dock at Middlesbrough is now available for vessels of 60 ft. beam.

NEW CATALOGUES AND TRADE PUBLICATIONS.

The A. B. P. Accumulator Company, Ltd., of Stockton-on-Tees, send us a handy list of A. B. P. accumulators for 1904.

Heathman and Co., of Parson's Green, S.W., forward a fully illustrated catalogue of their patent Telescopic Scaffold Towers.

Fairbanks, Morse and Co.—Catalogue No. 80A, is an attractively illustrated list of vertical gas, gasoline, kerosene and distillate engines, of 2, 3, 4 and 6 horse-power.

Abner Doble Company, San Francisco.—An illustrated pamphlet describing work executed by the firm in connection with the installation of Tangential Ellipsoidal Water-Wheels.

J. H. Sankey and Son, Ltd., of Essex Wharf, Canning Town, E., forward an attractive catalogue, printed in various colours, and comprising bricks, cements, etc., fireclay goods and sanitary appliances. It includes a very artistic reproduction in colours of specimen floor tiles, dadoes, and glazed bricks.

George Hattersley and Sons, Ltd., Keighley.—We are advised by this firm that they have purchased the sole European patent-rights of the "Phillip's" Automatic Self-Adjusting Friction Clutch. The clutch is fully described and illustrated in a 16-page pamphlet, which can be obtained from the firm on application.

Edward G. Herbert, Ltd., forward a new catalogue of metal sawing machines, machine tool accessories, cramps, packings, angle plates, etc., which should be obtained and filed for reference. The firm notify us that owing to the rapid growth of business they have removed from Cornbrook Park Works to larger premises at Rosamond Street East, Manchester.

United States Metallic Packing Company, Ltd., of Soho Works, Bradford, have issued a booklet of 140 pages, describing the salient features of the United States Metallic Packings (of which we understand 160,000 have been supplied to firms in all parts of the world), and giving the names of firms throughout the United Kingdom who are using this packing.

W. and T. Avery, Ltd., Soho Foundry, Birmingham.—List No. 51 has numerous illustrations and deals with weighbridges for wagons, carts, railway trucks, locomotives, etc.

We have also received Section No. 24, Dairy Scales, and List No. 37, dealing with Avery's Triple Recording Weighing Machine, by which the weight can be taken and a permanent record printed on tickets in three different standards. The new patent is extremely simple and should meet a long-felt want.

W. H. Bailey and Co., Ltd., Albion Works, Salford, Manchester.—A complete catalogue of Foster's Patent Pressure Reducing Valves and Pump-Governors. This is a large quarto catalogue with a striking cover printed in black and white. It is claimed that the "Foster," is the only valve by the use of which such a saving in first cost and wear and tear can be effected, as by reason of its compensating spring toggles, it is the only spring-controlled valve which can open full-bore and work without wire-drawing.

S. Howes Co. (L. E. Barbeau), 64, Mark Lane, E.C.—From this company we have received a compact and freely illustrated list of turbines, water wheels, motors and pelton wheels, "Little Giant" turbine governors, steel plate fans and heaters, "Eureka" grain and seed cleaning machinery, maize degerminating, flaking and cleaning machinery, coffee and rice cleaning, hulling, pulping, and drying machinery, flour mill machinery and supplies, grinding mill and dust collectors. The opening pages are devoted to a description of the "Little Giant" turbines. For these it is claimed that they are by far the most practical and efficient motors for the utilisation of water power.

The Unbreakable Pulley and Mill Gearing Company, Ltd., of West Gorton, Manchester, have issued an instructive collection of notes on various methods of power transmission in works and factories. As the firm point out, the difficulty lies in determining to what extent each system should be utilised. This pamphlet enumerates and discusses the different factors which have to be considered and indicates that the decision in any given case should be based on the whole result, and not upon some striking apparent advantage obtainable in some one direction. It is remarked that caution and careful consideration are especially needed in regard to "the seductive claims of electricity."

Horsfall Destructor Company, Ltd., Lord Street Works, Leeds.—"Destructor Details. The Latest Improvements and How they are Obtained" is the title of a neat little pamphlet which has just been issued by this firm. The pamphlet owes its interesting character chiefly to the very numerous half-tone illustrations, all of which are admirably done.

In a pamphlet received from the same firm, containing many excellent plans and diagrams, M. J. Leurs, Alderman of Public Works of the City of Brussels, describes the new Horsfall Destructor plant erected in that city. The pamphlet is of especial interest to municipal engineers and town councillors. We gather that the civic authorities of Brussels, in installing the Horsfall system, were impressed with the excellent record it had already secured at Hamburg.

The British Westinghouse Electric and Manufacturing Company, Ltd., Norfolk Street, Strand, in connection with the recent Colliery Exhibition, have issued a finely illustrated pamphlet entitled "Electricity in British Collieries." There are many illustrations of various plants in which Westinghouse machinery is installed, and not the least interesting section of the pamphlet is a table on page 11, giving some financial results of electrical working in collieries.

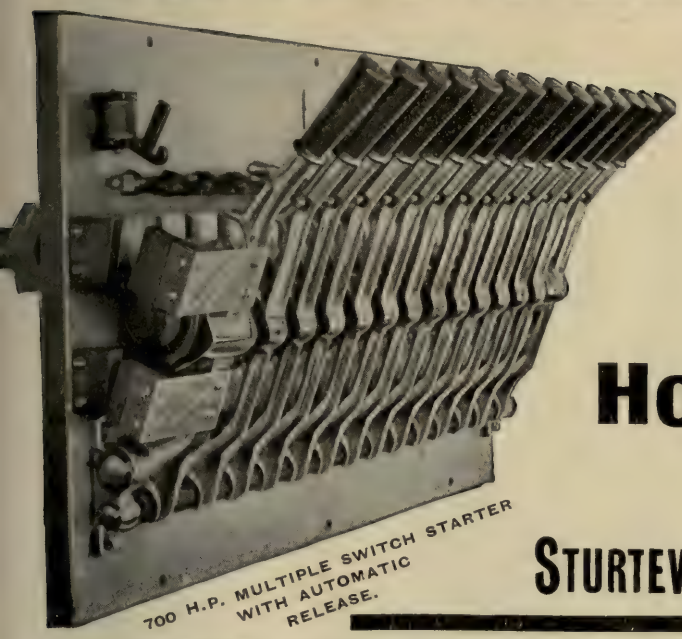
We have also received circular B 1070, describing and illustrating Polyhpase Induction Motors, Types "C" and "CB" for constant speed.

The same firm send us a copy of a compact diary which they have issued in connection with the St. Louis Exposition. This affords space for data from the 1st of June to the end of November, and includes a quantity of useful tabulated information. This will help visitors to find their way about St. Louis, and will also enable them to obtain a comprehensive view of the Westinghouse exhibits.

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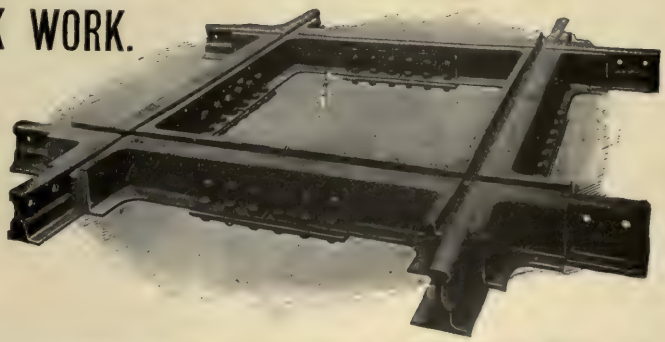
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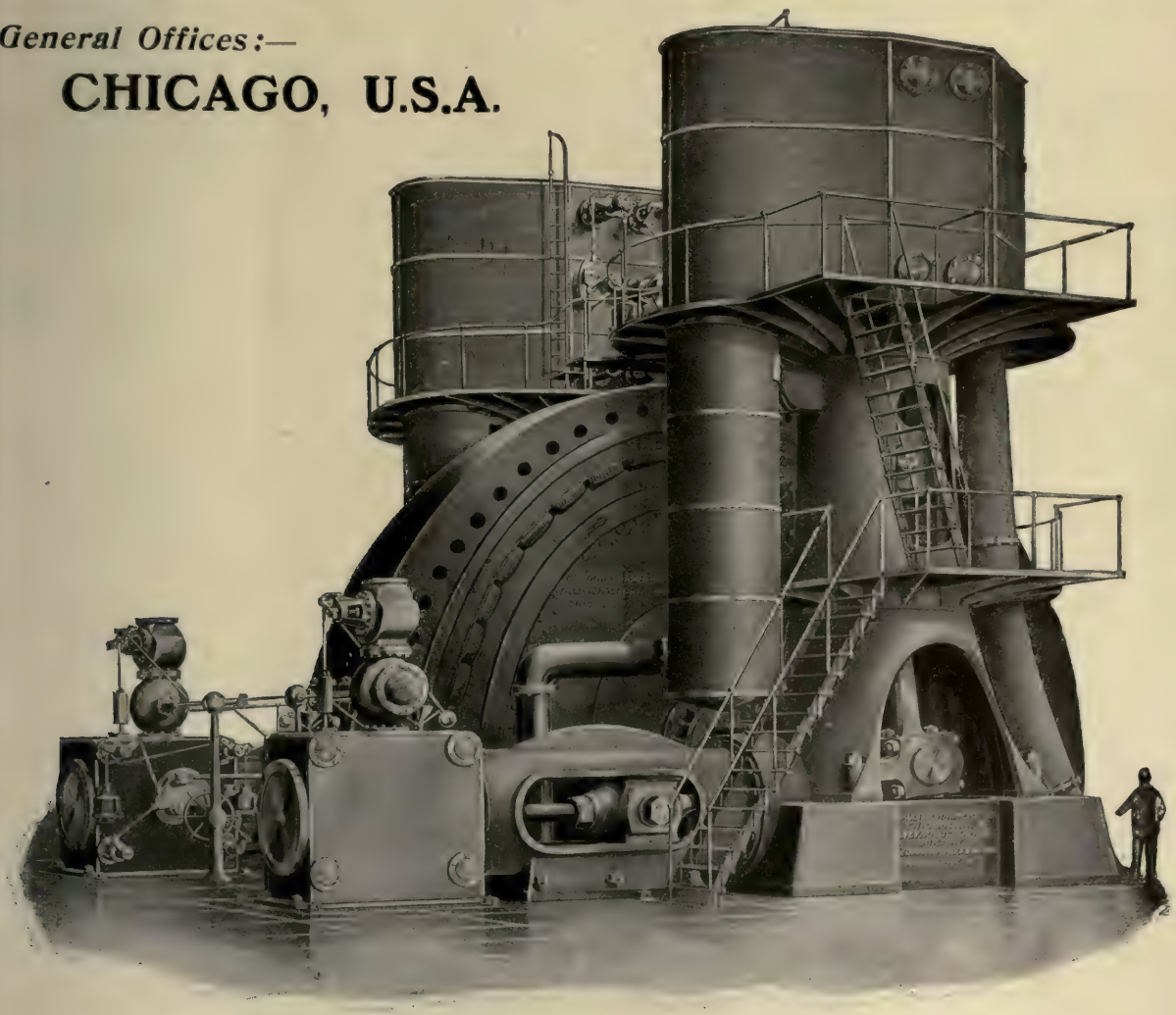


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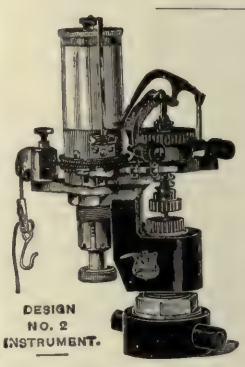
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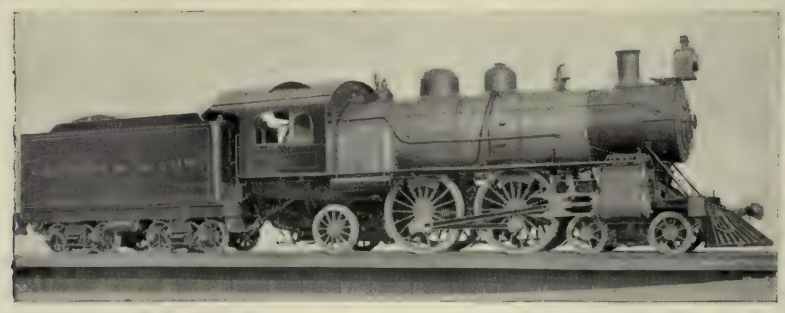
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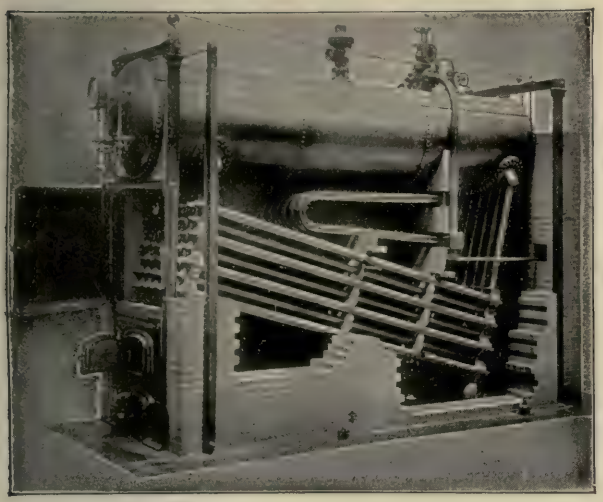
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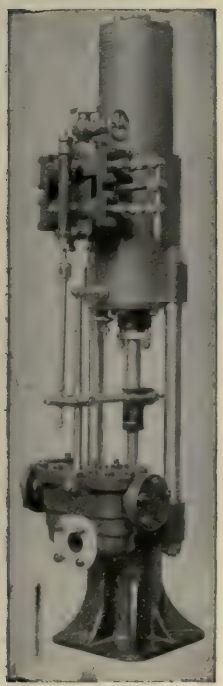
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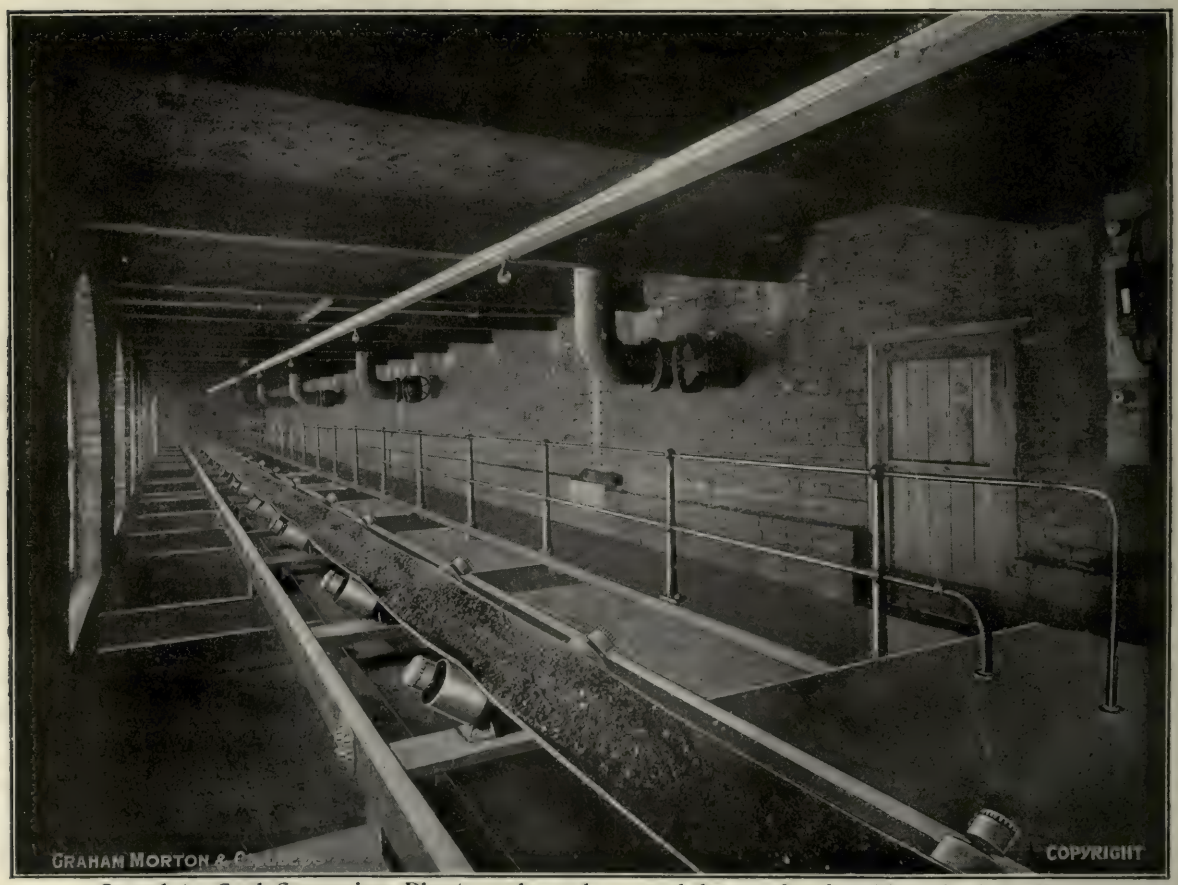
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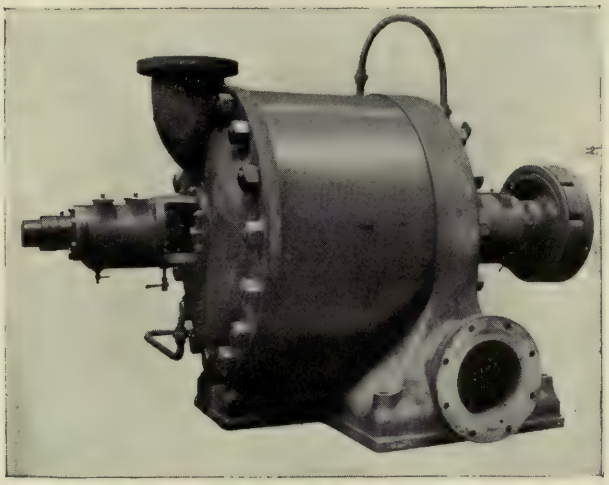


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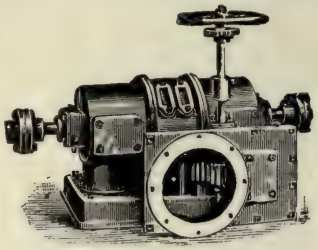
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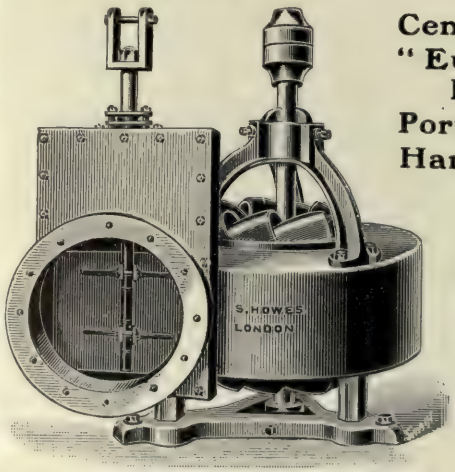


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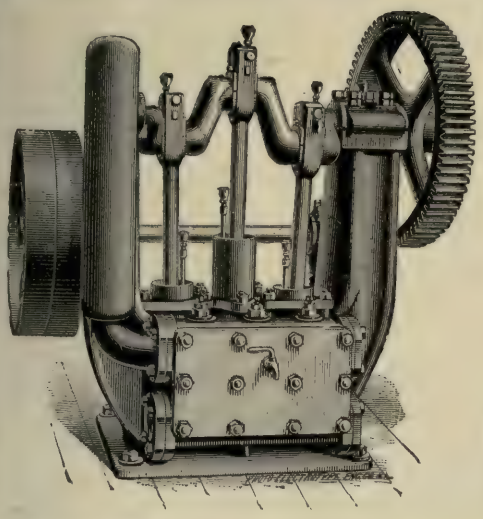
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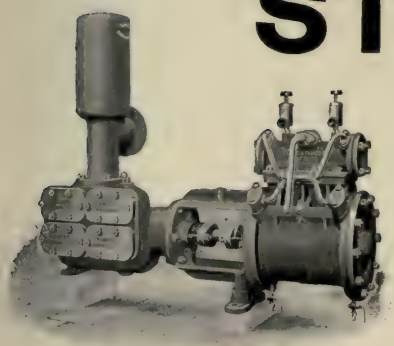
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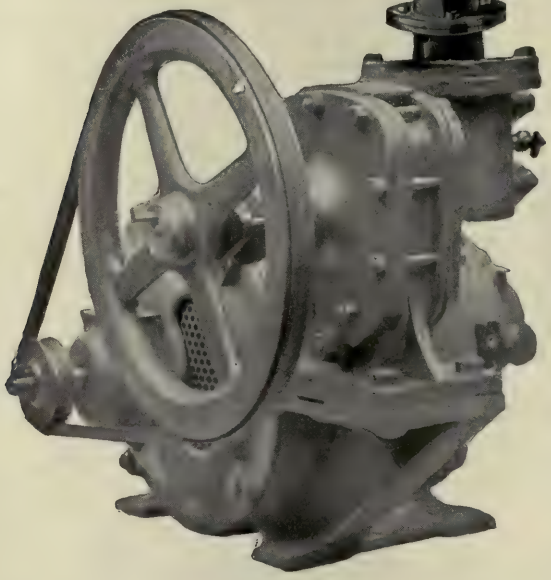
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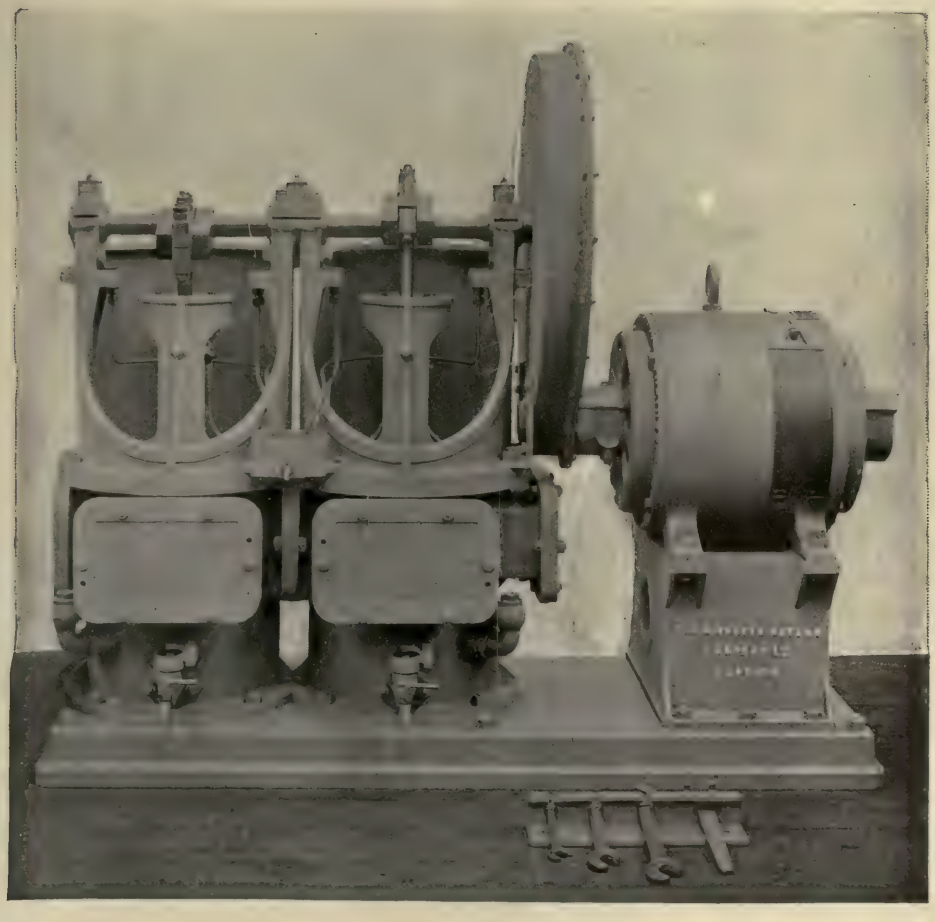
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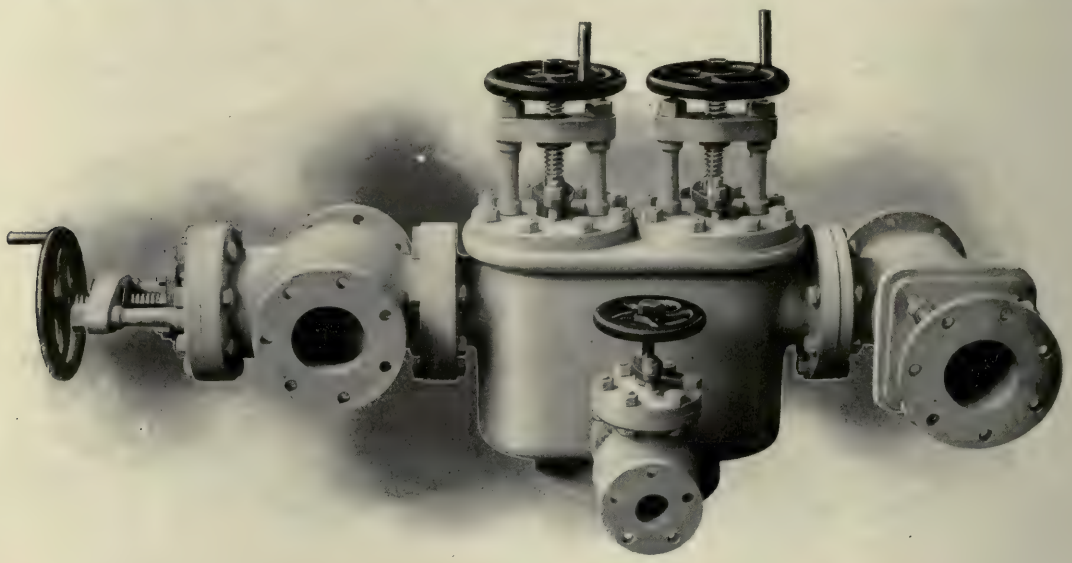
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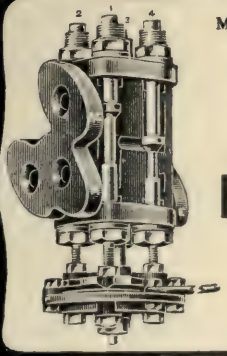
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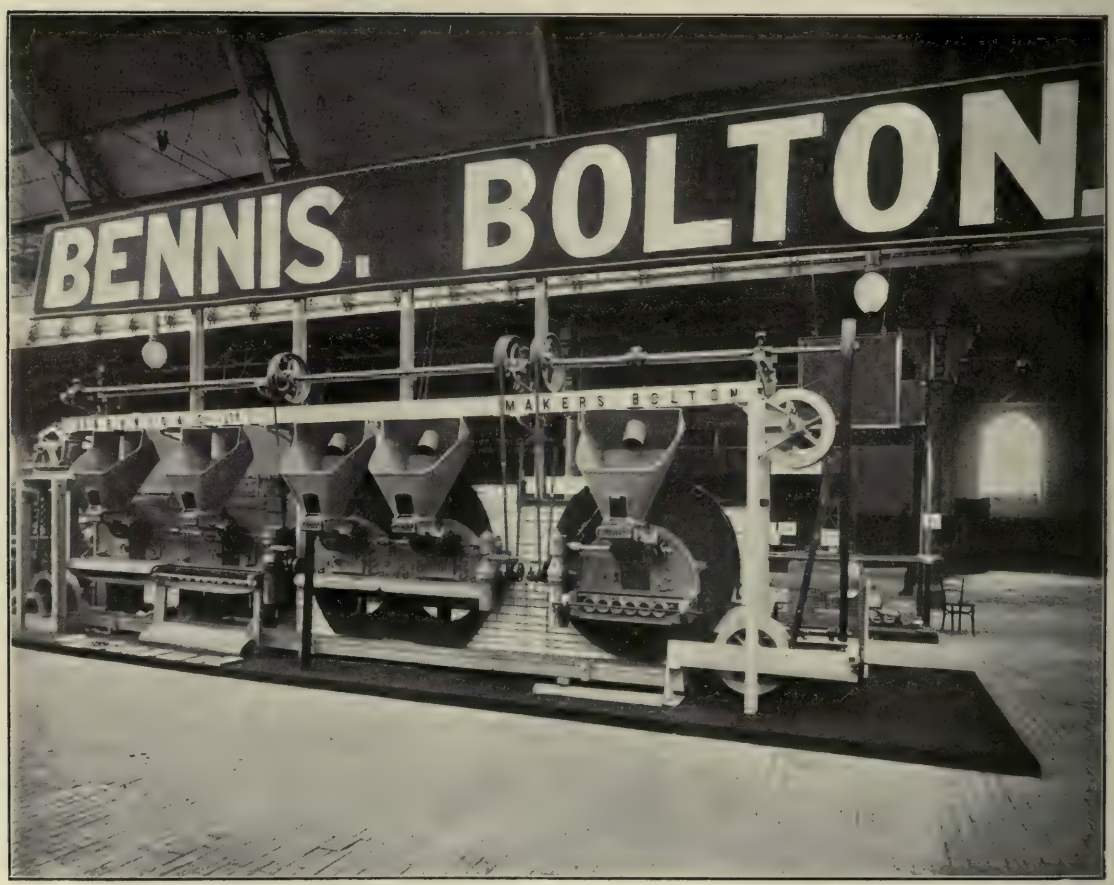


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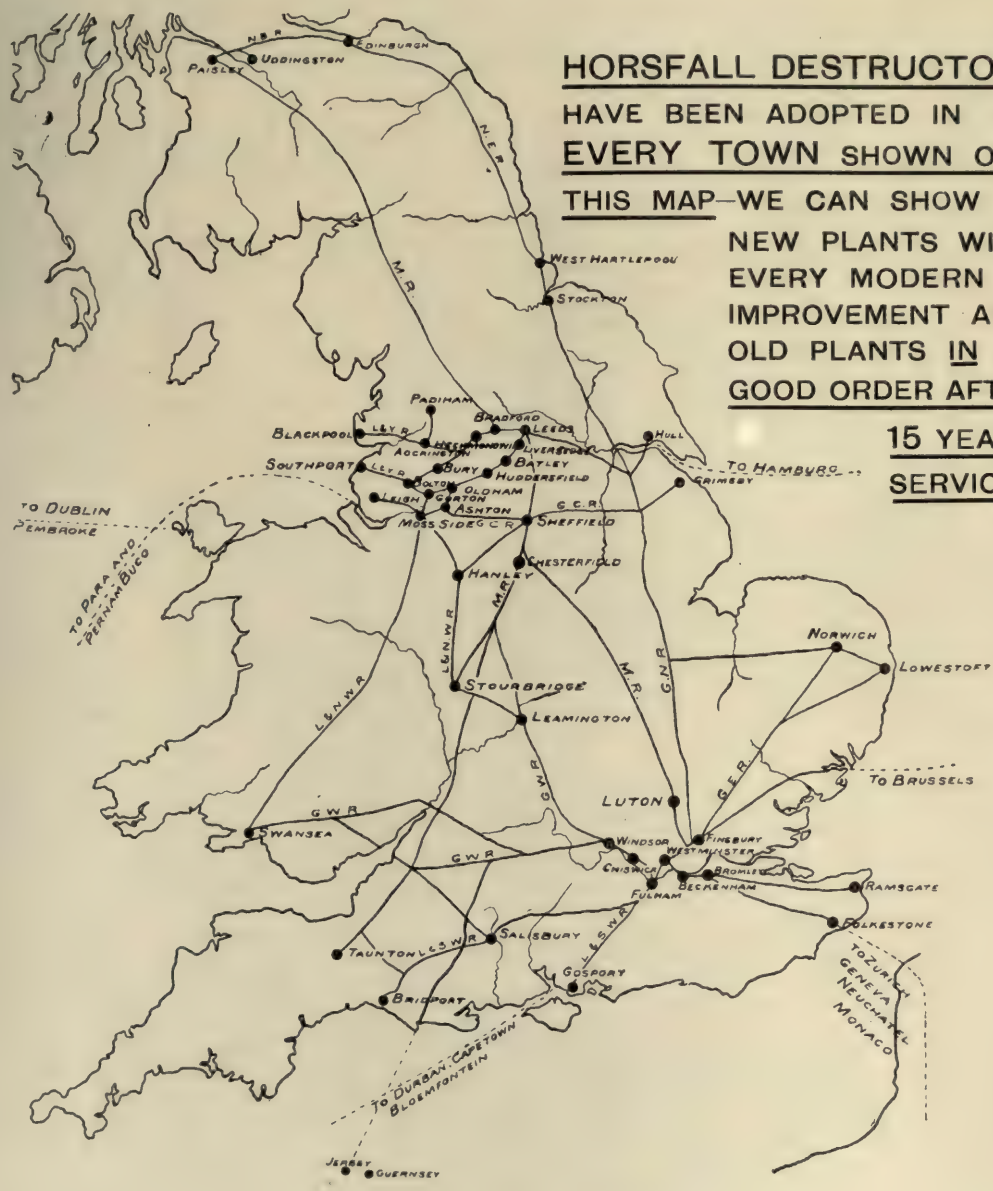
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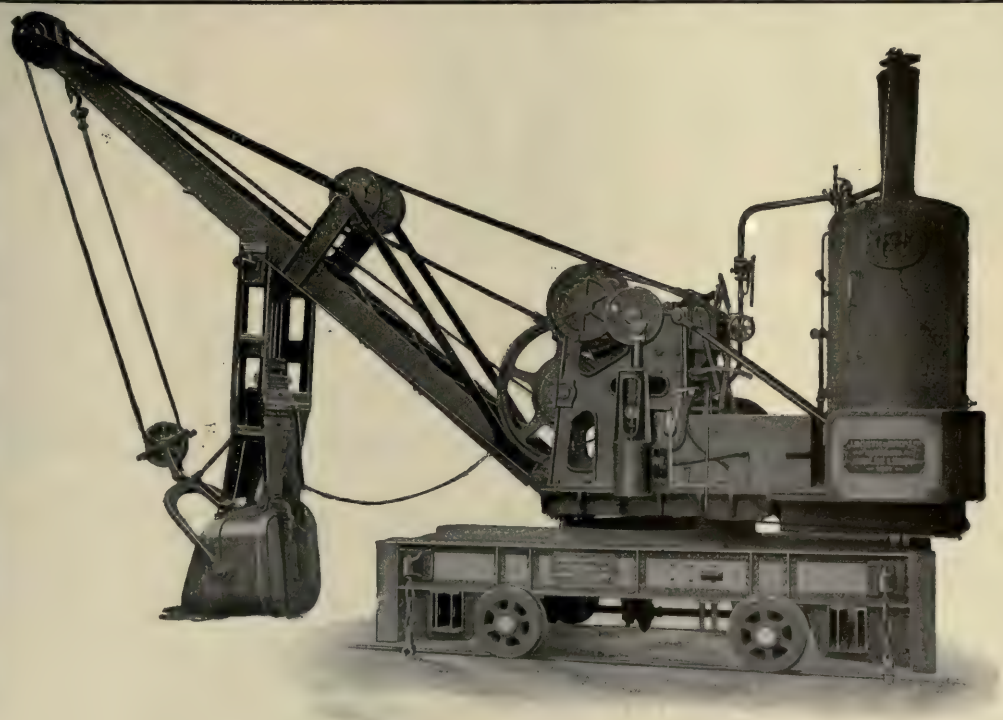
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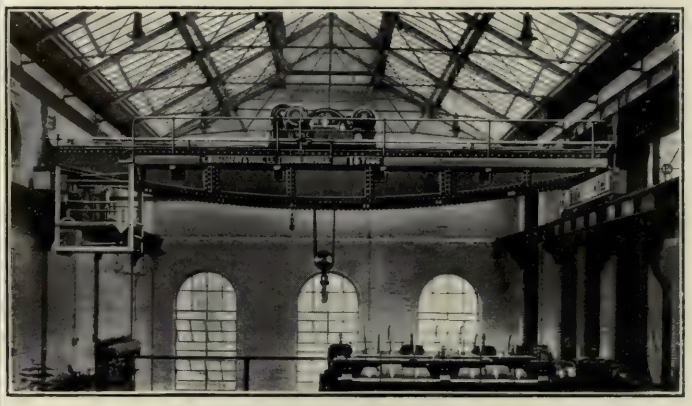
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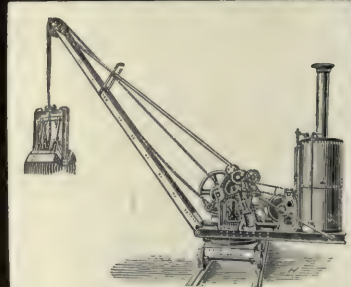
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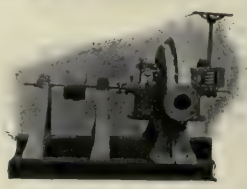
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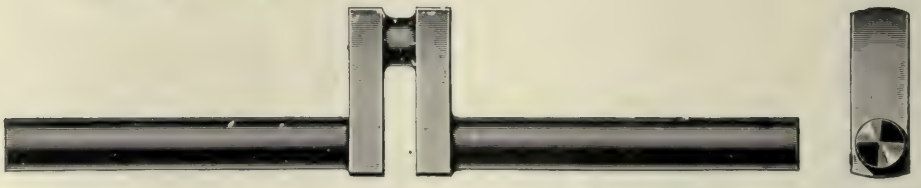
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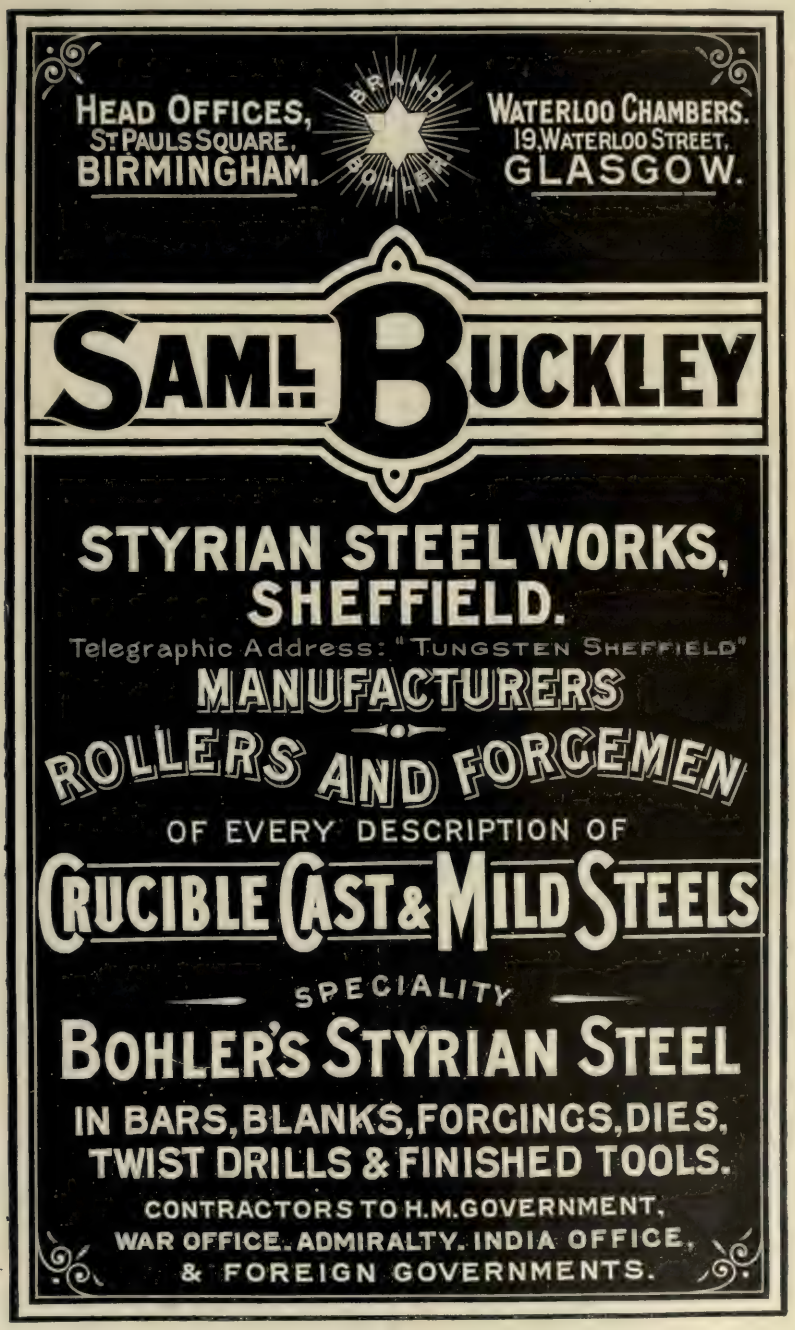
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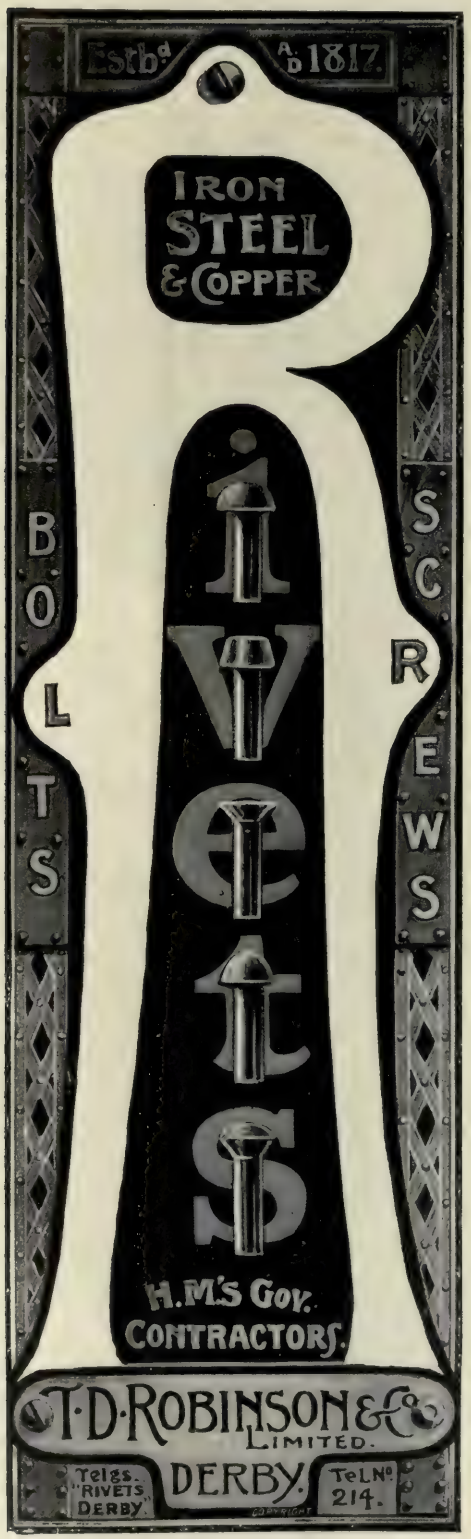
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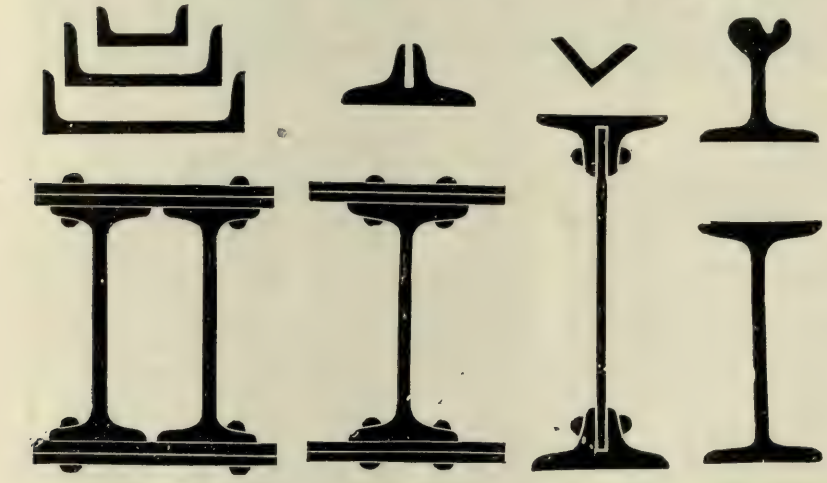
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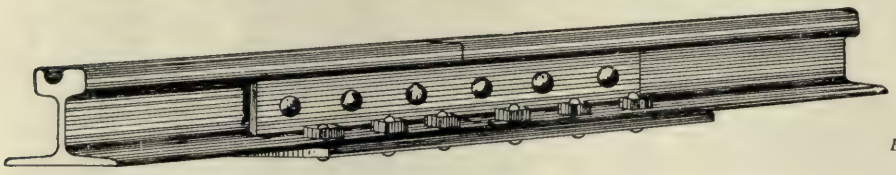
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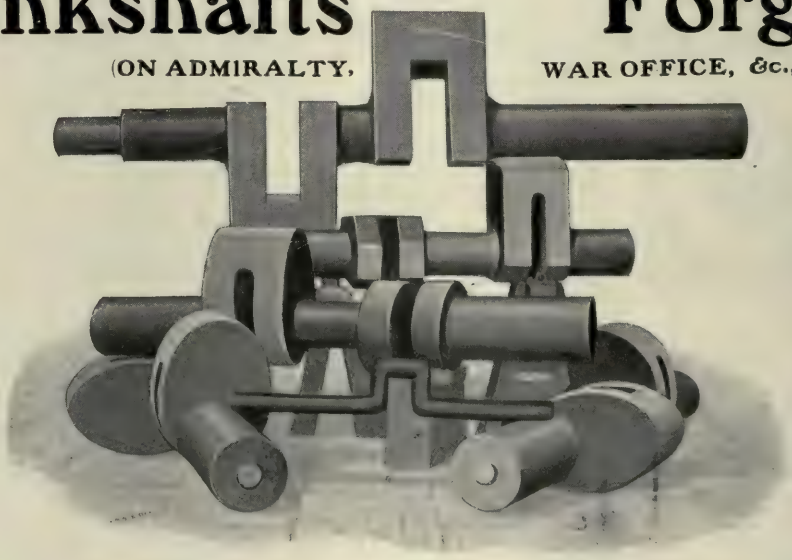
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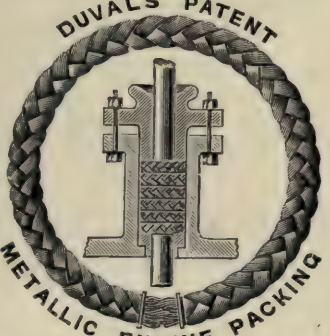
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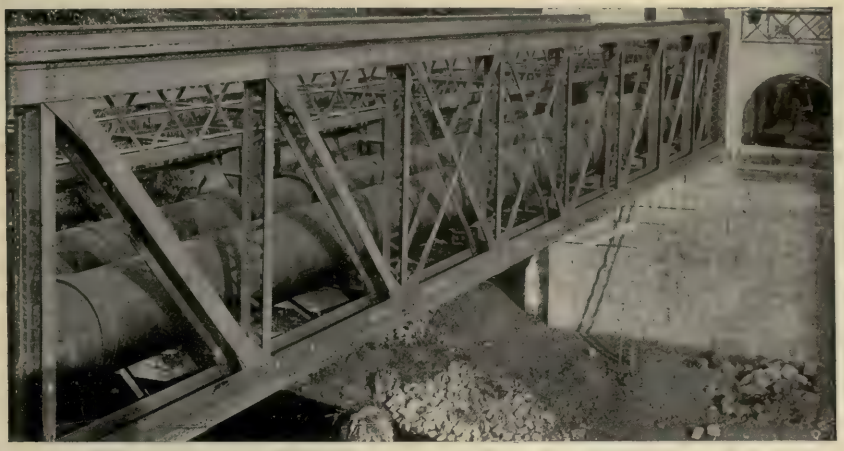
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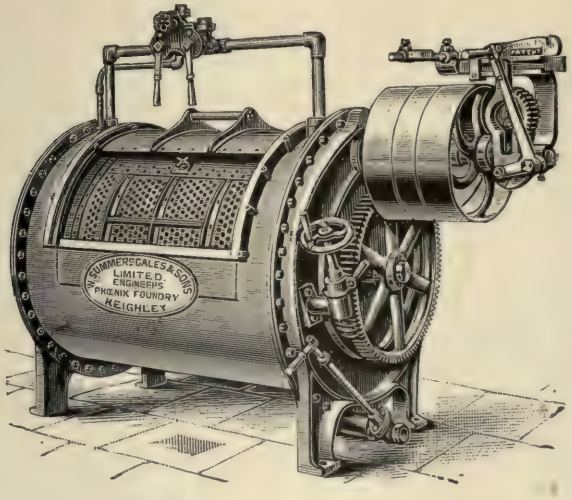


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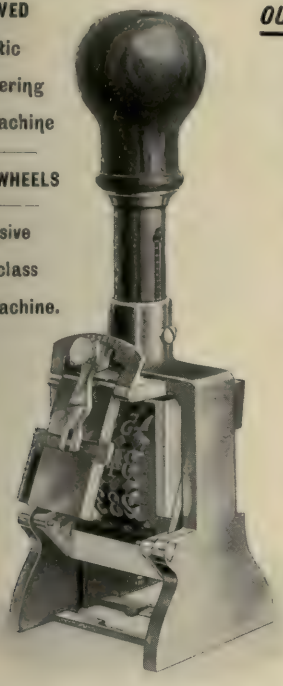
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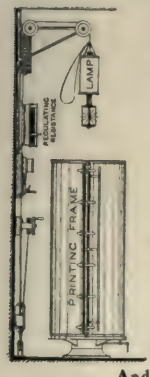


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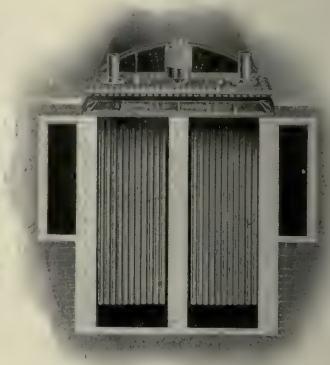
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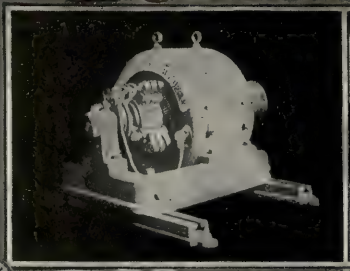


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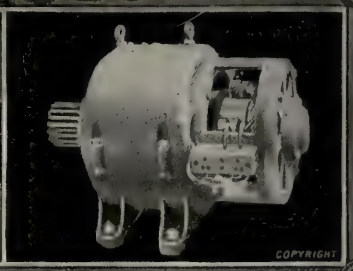
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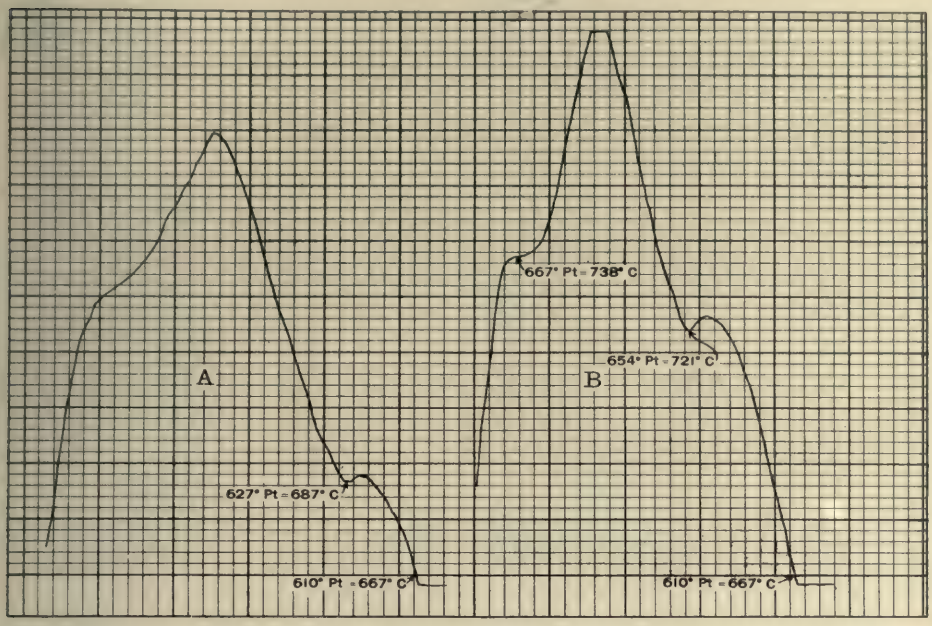
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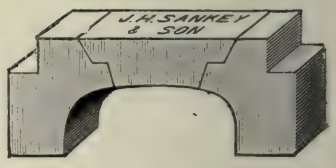
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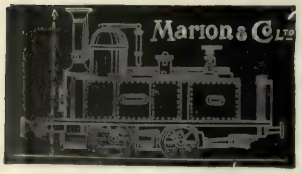
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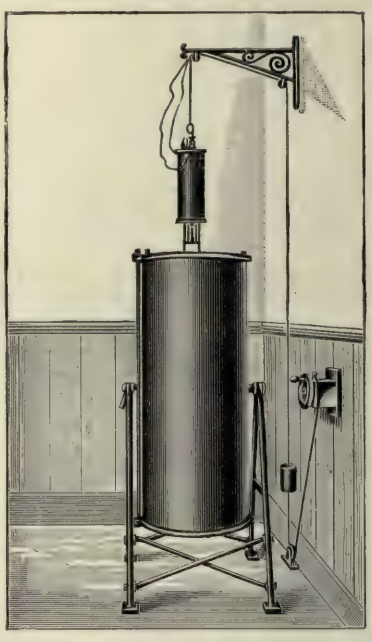
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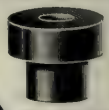
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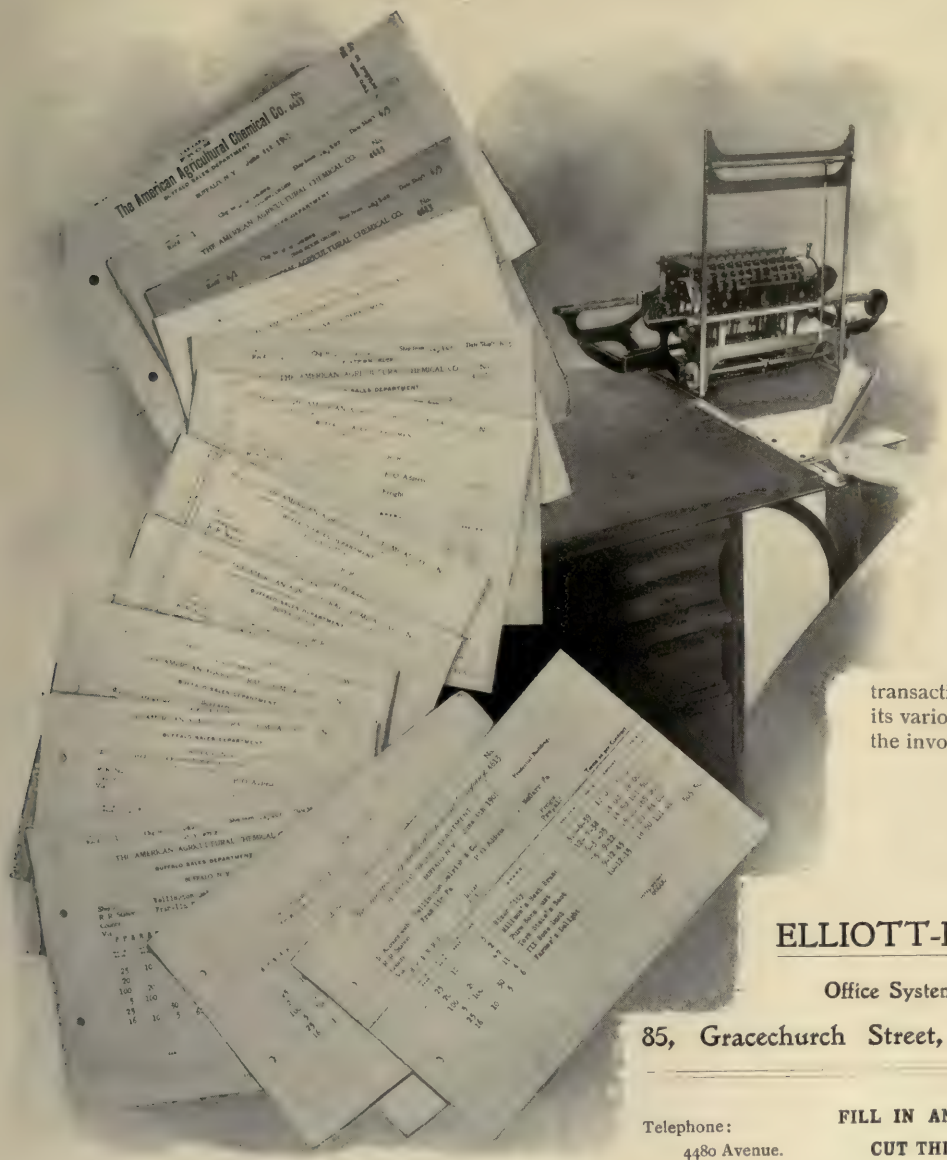
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This illustration shows **13** Records of differently printed forms, varying in size, taking in every transaction, from the order with its various departmental copies to the invoice and wagon label.

ELLIOTT-FISHER CO.,

Office System Department,

85, Gracechurch Street, LONDON, E.C.

Telephone:
4480 Avenue.

FILL IN AND CUT THIS OUT.

Are you making Invoices with Pen?..... Pencil?.....or Typewriter?.....
Do you Press-copy same?.....or take Carbon copy?.....or use Manifold Books?.....
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Do you manufacture and ship from original order as received?....., or do you copy the order for your shipping and other departments?.....

Is it desirable or necessary for you to make more than one copy of your orders?.....
If so, how many?.....

Name.....

Business.....

Date .....1904.

Address.....

CONTROL

OF

TIME AND COSTS

IN

WORKS AND OFFICE.

COMPLETE SYSTEMS ORGANISED AND INSTALLED.

For Details and Appointments, write—

International Time Recording Co.,

171, Queen Victoria Street, LONDON, E.C.;

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EMPLOYERS OF LABOUR

Can save at least 5% ON THEIR WAGES BILL, and thousands of employers do so by the use of the

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which are automatic machines for registering the hour and minute at which Employees start and finish work,

and, with New CARD ATTACHMENT for COST KEEPING.

They are of British Manufacture Throughout.

They are absolutely the best Time Recorders in the World.

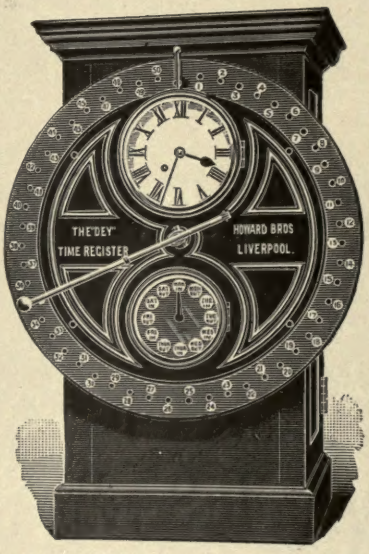
They are the cheapest up-to-date machine on the market.

They are guaranteed perfect in every detail.

THEY COMPEL PUNCTUALITY.

The "Dey" time and wages sheets combined do away with time books, wages books, and save 90% of clerical work. They are adaptable to every requirement, no matter how complicated.

A firm using 15 machines writes: "We shall be sorry when we change the boiler-shop machine, as it was one of the earliest, and has had the roughest of usage together with the maximum of vibration, and rudest of shocks; but it has gone on working the whole time (nearly six years) night and day, and when it goes to you for repairs, it will be the first time it has been in the infirmary."



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HEAD WORKS & REGISTERED OFFICES,

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STANDARD OAK-TANNED LEATHER BELTING.

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"GILBERT" WOOD SPLIT PULLEYS. PRINCIPAL AGENTS. LARGE STOCK HELD.

SOLE MAKERS OF "TEON" BELTING the Premier Heat, Steam, Water & Acid Proof Belt.

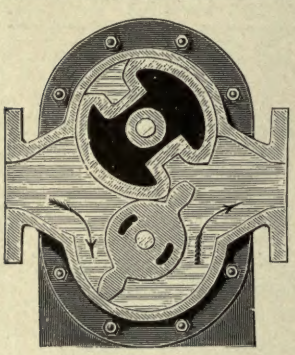
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THE . . .

"DRUM" PUMP.

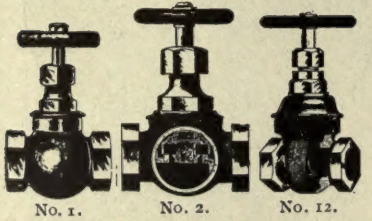
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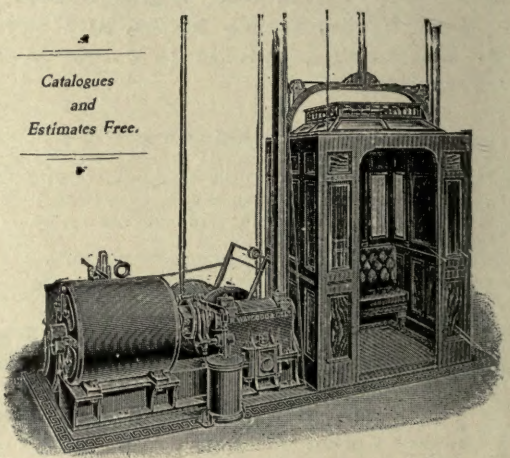
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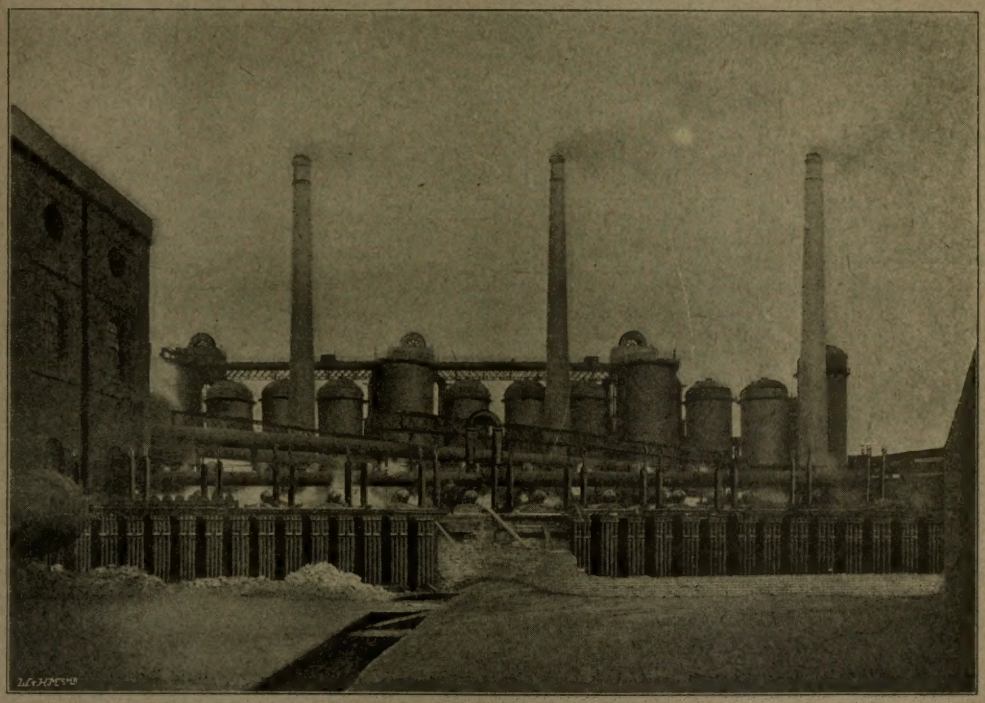
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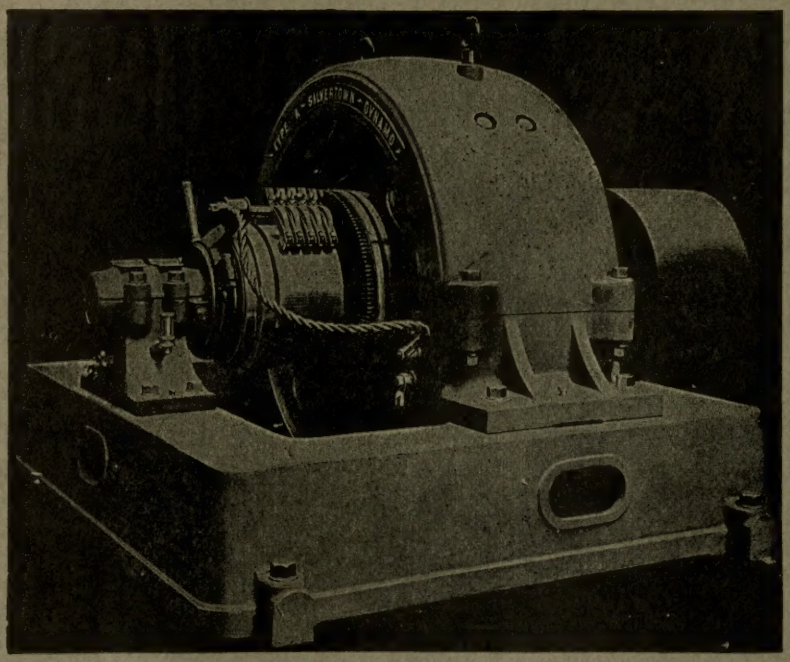
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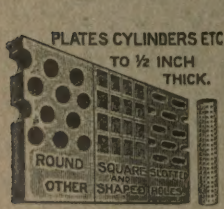
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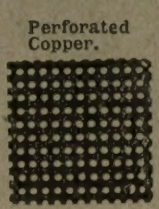
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